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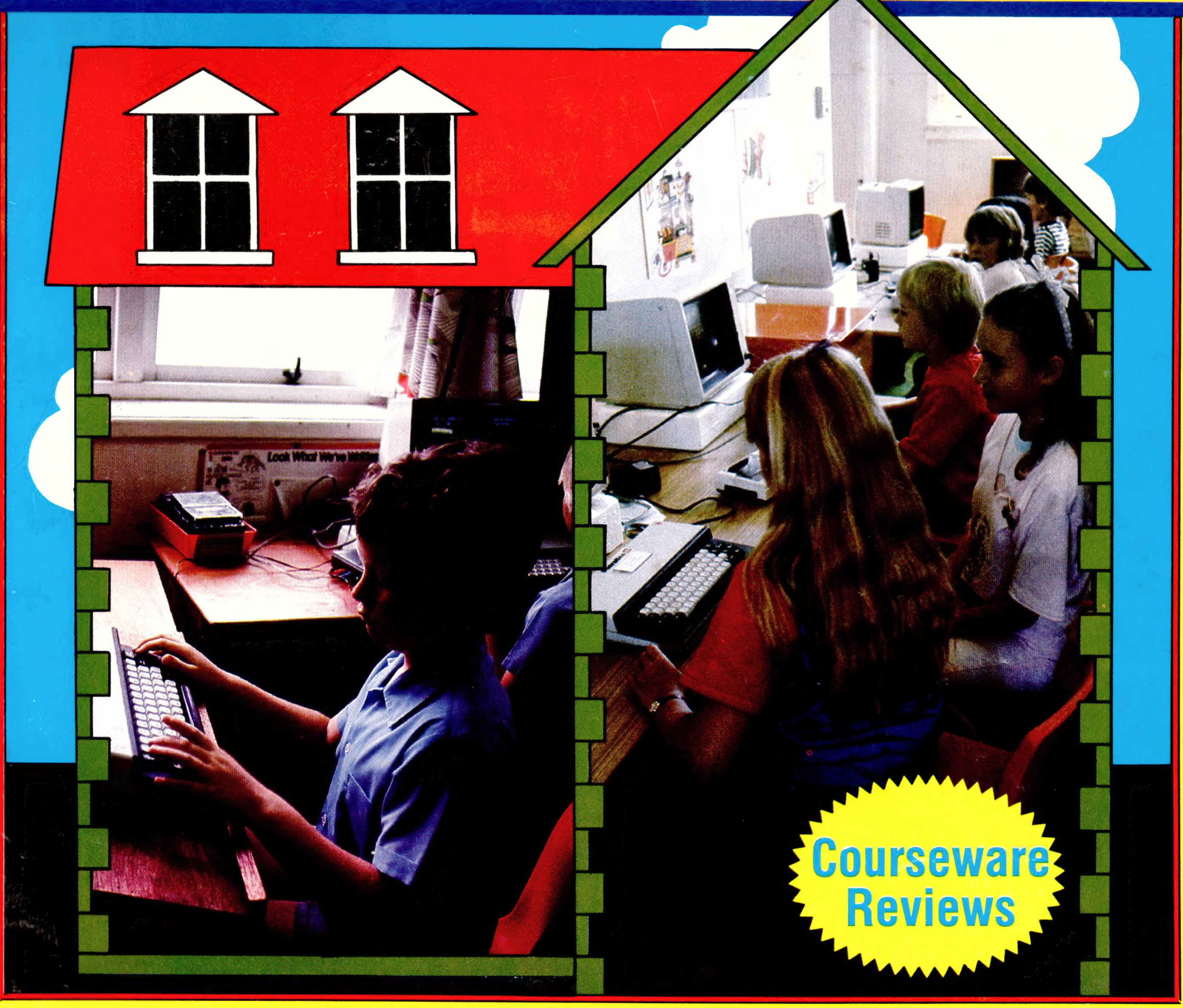
Computers — in — Education



Courseware Reviews

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Networking: Buzzword or Blessing?

Software: Choosing & Using

Opinions: Kids, Teachers, Experts

Home Computers: To buy or not to buy?

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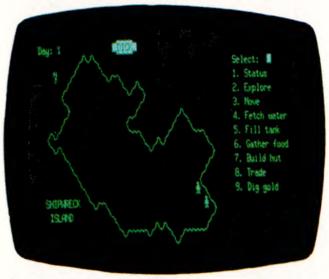

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Day: 1                       Select:
                             1. Status
                             2. Explore
                             3. Move
                             4. Fetch water
                             5. Fill tank
                             6. Gather food
                             7. Build hut
                             8. Trade
                             9. Dig gold
SHIPWRECK
 ISLAND
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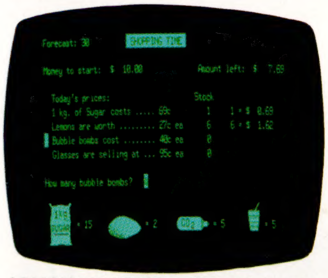

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Forecast: 30        SHOPPING TIME

Money to start: $ 10.00          Amount left: $  7.69

  Today's prices:                    Stock
  1 kg. of Sugar costs ..... 69c       1     1 • $ 0.69
  Lemons are worth ......... 27c ea    6     6 • $ 1.62
  Bubble bombs cost ........ 40c ea    0
  Glasses are selling at ... 95c ea    0

How many bubble bombs?

 1kg SUGAR • 15       • 2      CO2 • 5        • 5
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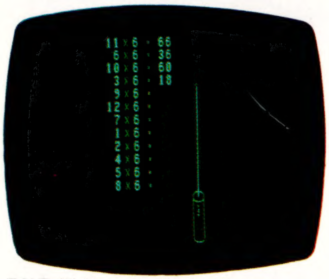

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 6 x 6 = 36
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 3 x 6 = 18
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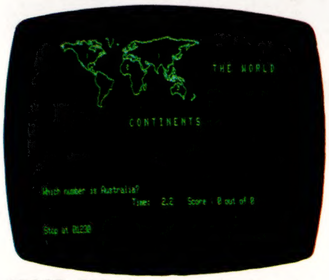

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                          THE WORLD

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                 Time:  2.2   Score : 0 out of 0

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Editorial Comment

EDITOR
Natalie Filatoff
ART AND DESIGN
Toni Henson
EDITOR-IN-CHIEF
Jane Mackenzie
MANAGING EDITOR
Jamieson Rowe
CONTRIBUTORS
Prof. Jonathon Anderson, Dr John Barrett, Jon Barrett, Bev Haigh, the staff of 'Horan, Wall and Walker', Norman Kemp, Frank Lee, Evan McHugh, Mike Newnham, John Oakley, Dr Robin Porter, Barbara Thompson, John Treloar, Rose Vines.
ADVERTISING PRODUCTION
Danny Hooper
ADVERTISING
David McDowell
(National Advertising Manager)
Damien Prins, Andrea Beaty,
(NSW Advertising)
David Farrington
(Victorian Advertising)

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'No more pencils, no more books ... ?' Not quite. We mentioned last year in 'Your Computer' magazine that the software which could replace a good teacher hadn't been heard of in our office yet. That still stands, and I think we'd all agree it would be a bad thing to reduce the human element in teaching.

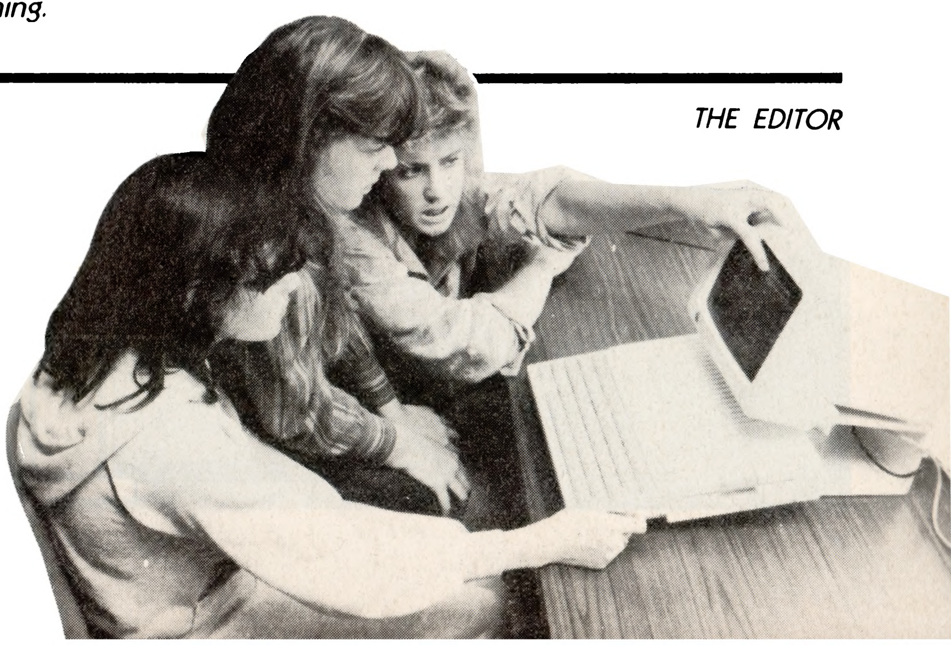
Nevertheless, the proliferation of computers is steering us further and further into what is termed the 'information society'. And there is a real danger that people who don't know how to access computer-held information will be disadvantaged in the near future, while those who do will wield a greater power. It is mainly for this reason that we should be helping children, the citizens of our increasingly information-based society, to develop a familiarity with computers and associated technology.

In Australia, the government, educators and parents have taken major steps towards providing for this element in schooling. But both knowledge of the requirements and the necessary resources are in general not widespread enough to ensure a high standard of computer education for all students.

Perhaps one of the greatest difficulties in achieving worthwhile goals in this area is that the majority of teachers and parents have not had access to the kind of information which would allow them to make the right decisions about which equipment to buy and which software will teach useful skills. The other obstacle is, of course, money.

While this publication doesn't contain several coupon-style blank cheques, it does aim to provide useful and hopefully inspirational material for those starting out in computer education. Both original and previously published articles, reflecting many years of collective experience, have been drawn together to form what we hope will serve both teachers and parents as a handbook for approaching this new aspect of learning.

THE EDITOR



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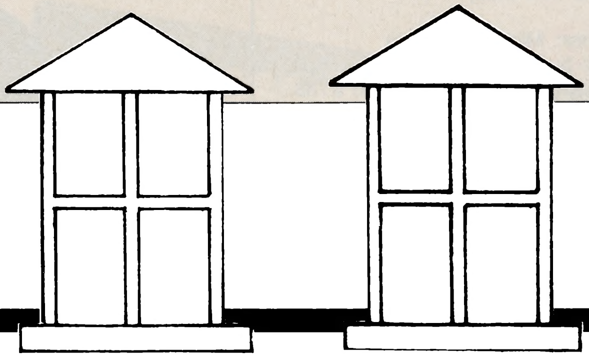

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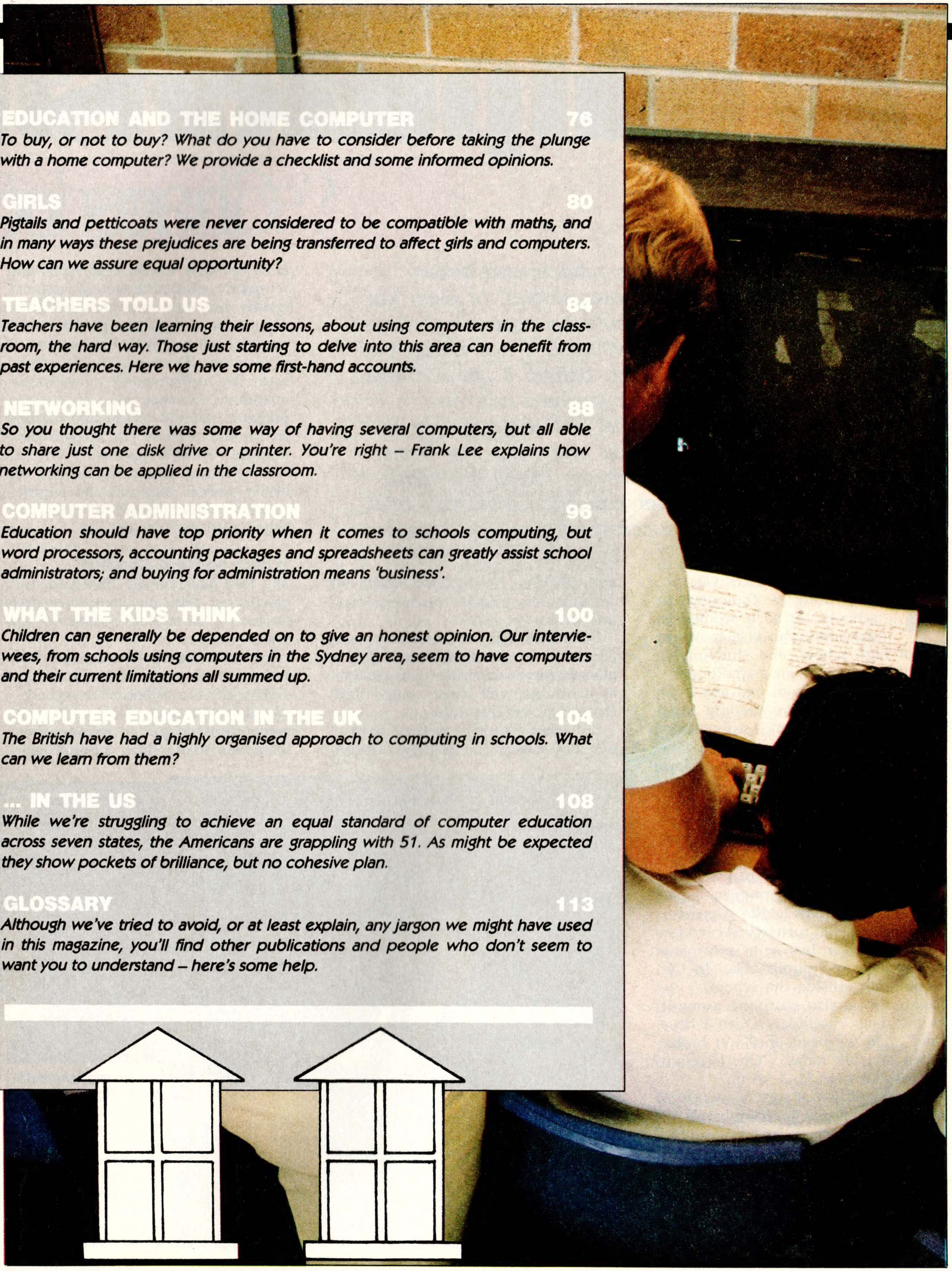

Computers i

Chaos or

What is happening in Australian schools and tertiary institutions in relation to computer studies, or even just computer awareness? What should be happening? The overall impression is one of confusion, if not chaos, but is there actually a coherent plan behind it all? We asked four experts – people who are involved both in education and computing – what the problems are in introducing computers to schools and what they would like to see take place. Their answers reveal the varied opinions within the computer education area, and offer some suggestions for the successful future of computers in education.

Five years ago there was no such thing as 'computers in schools', or so it seemed to someone who was there, in senior high school, and studying traditional subjects in a traditional manner. If the school had any computers, they were beeping and whirring away behind closed staffroom doors. We may have discussed 'The Effect of Technology on the Workforce' in that highly disorganised and therefore token subject, 'General Studies', but computers ... ?

And so it must still be in many schools, except that the word 'computers' is probably bandied about, shouted down phones, typed hopefully in letters to the 'Department', whispered furtively in corridors, contemplated in fear or in anticipation by teachers and pupils alike. In the community outside the school, 'computer' is also scurrying around in the daily vocabulary: 'Can I have one?', 'Do we need one?', 'It broke down at work today', 'Oh, I couldn't do without one', and so on.

Computers are a part of our lives, and most children in school now will encounter them in some way when they join the workforce, or when they pursue further education. Much advertising has latched onto the computer's high profile in the public mind and onto the fact that parents are always anxious to give their children the best education and the brightest possible prospects for the future.

Politicians use funds for computer education as enticements, computer manufacturers advertise their products as items that will boost your child's chances of employment.

But what happens to the funds when they leave the political platform? How are they used? Why can't you see many results? If you do see results, are they enough – what can one or two computers in a school be used to achieve? What about the curriculum? Should children *have* to learn the fundamentals of computer operation? Do they need to be prepared socially for a computerised environment? How can computers be teachers? What if you don't buy one – will Johnny spend the rest of his life in pinball parlours, will Jenny end up a beach bum? Maybe you'd better buy one just in case?

What's So Hard About It?

The first question we posed to our panel was: *What are the main problems involved in introducing computers into schools?*

Professor Phillip Grouse was first and emphatic with, "Money".

Professor Juris Reinfelds argued that it is the teachers. He said, "It's much easier to put in money. But there is a tremendous amount of

Our team of experts: left, Philip Grouse, former Professor at the University of New South Wales and now an independent software developer; above left, Dr John Barrett, lecturer in the School of Education at Macquarie

n EducatioN

Coherence?

inertia in the teachers who have been in the workforce for a long time. They have always done things in a certain way, and this new-fangled technology is not going to change their ways. Therefore, there is a large diplomatic education effort required, in addition to the hardware, and this is what the government is not doing at the moment."

When challenged in this opinion by Grouse, who said that the schools who do have teachers with the skills, or at least the incentive, still lack the funds, Reinfelds continued: "Yes. And there is nowhere those teachers can go, except perhaps pick up ad hoc subjects from some place, or do an ad hoc course of some two or three weeks put on by some entrepreneur who wants to make money more than give knowledge.

"What did Singapore do? Singapore made a plan which said 'We need secondary teachers skilled in computing.' So they went to the national University of Singapore and said 'How much will it cost?' The University quoted so and so many dollars, and the government put the money down. So now they're taking 34 select teachers each year and putting them through a two-year training program – out come expert computer science teachers who will then train other teachers."

Clear Objectives Required

Dr John Barrett added the need for planning: "Overall it also needs policy and planning. You've got to have some idea of what we're trying to do. I'm not saying people should be sitting around for years planning, but to even start teacher training or throw money in anywhere is just an irrational kind of thing to do without clear objectives."

"That's right," agreed Grouse. "It's not so much a matter of teaching computer science per se, but of working out what you actually want to teach, and how you want the computers to be used. It's one thing to say, okay, we're going to teach teachers about computers. In fact computers could be used with very little computer knowledge in areas apart from computer science. For example, in geography, history and so on, which require a knowledge-based system of learning."

John Hughes combined all these aspects, saying, "I think the crux of the issue is, are we talking about introducing computers to schools as an aid to the teacher, or are we talking about introducing computing as a discipline to schools?

"I think the former can probably be done fairly easily. It lends itself to the sort of short-term training that's available in-service and so on.

"I'm actually very worried about the longer-term prospects of introducing computing as a discipline. I think the problem is threefold. I think that within the teaching service there's inertia, as Juris said, but there's also antagonism towards the introduction of computers. There's a lot of fear about them. The second thing somebody mentioned was teachers with skills and I honestly believe there are very few teachers out there with what I call computing skills. There are teachers who've learnt to come to grips with computers, there are teachers who use computers in a domestic situation, but there aren't many teachers out there who understand computing. And the third problem, of course, is policy. We've got to give some direction."

Computers, Teachers and the Software Problem

With this we asked *How can computers be introduced as aids to teachers?*

Professor Grouse mentioned 'expert systems', a term which should be explained before continuing. An expert system is a computer program which incorporates knowl-

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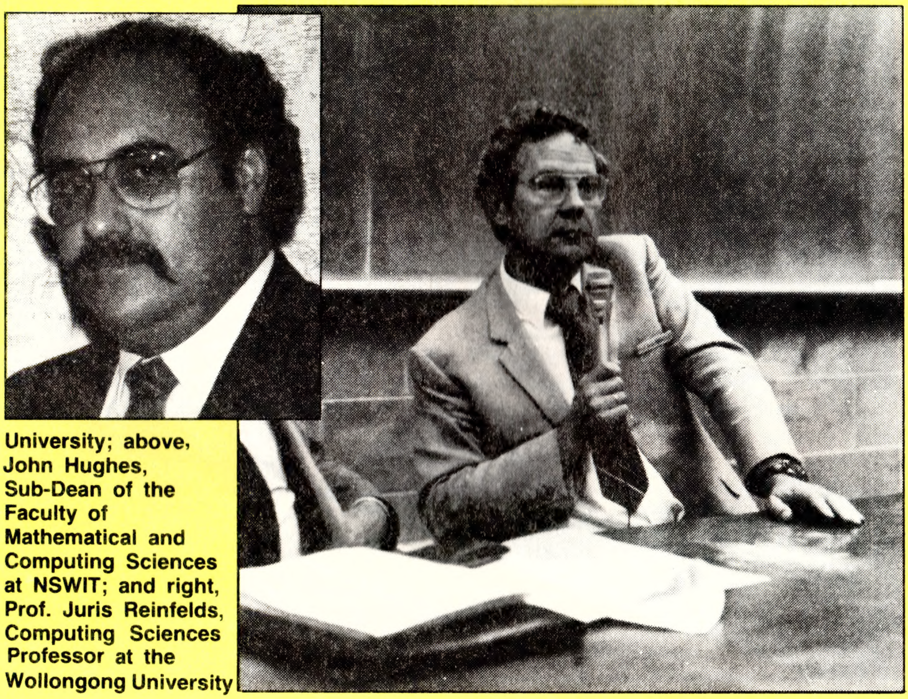

University; above, John Hughes, Sub-Dean of the Faculty of Mathematical and Computing Sciences at NSWIT; and right, Prof. Juris Reinfelds, Computing Sciences Professor at the Wollongong University

edge of some area from one or more experts, in such a form that this knowledge can be used to answer questions about that area. A complex expert system is represented by the kinds of medical enquiry programs presently under development. These will allow doctors to key in information on a patient's condition and receive help with the diagnosis. The programs might be interactive in that they will suggest further tests, the results of which would also be entered into the system to illicit a more informed reply.

Professor Grouse's comment was that many teachers using computers in schools at the moment are expecting them to function as expert systems, when both the computers and the majority of programs available to schools fall far short of such capabilities.

Expert systems are of course the highest level of aid computers could offer for teaching. Much of the educational software available now is directed towards drilling students, in question and answer form, on various subjects. More imaginative educational software is appearing with greater frequency, but because expert systems are so expensive to develop there are hardly any such products on the market.

Said John Hughes, "We have very few people who have the expertise in structural design to even design an expert system. And then we have very few authoring languages available that would even come close to what we're talking about. And then we have again a lack of support: there's virtually no money around for R&D of this type.

Professor Grouse added, "There is very little incentive for the people with the skills to write expert systems, or any other high-quality software, to provide it for schools. It costs a lot of money and a lot of time to generate this kind of thing and frankly the schools market is not seen by the commercial sector as a high profit area."

Encouraging Software Writers

It emerged that there were three possible solutions to the problem of supplying schools with quality software. One was to fund research and development of such programs in universities.

Said Professor Grouse, "I think the universities have the understanding of the curriculum in the high schools and the primary schools, and they also have the expertise to be able to put that stuff together. What they need is the incentive to do it. Right now they don't have the time or the incentive to work backwards into lower education.

Reinfelds agreed, "Yes. Two things are missing, you see. If you go to a university faculty of education or department of education, they have very little computer expertise. If you go to a computer science department, they don't know much about education. They have no time to learn, either. So the incentive has to

EARLY GAMES FOR YOUNG CHILDREN
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come to bring those two together, in at least one or two centres across the nation, and that will get it started."

John Hughes advocated implementing a system similar to that which was set up in Britain: "The Microelectronics Education Programme in the UK, which started some years ago, worked on the basis of funding the development of software. What's happening in Australian schools is that almost invariably the money that's being provided by the Federal Government is being given back to either the systemic schools or to the private schools in each state to decide what they want. That wasn't what happened in the MEP. They set up two independent people as the directors of the Microelectronics Education Programme. They called for input for projects that they wanted and it came, some from schools, some from commercial organisations and some from universities. Basically they evaluated the proposals that were put to them and funded the ones they thought were worthwhile. They funded them to various levels, with the ultimate aim that the software should be commercially available. In other words, they would pay for the development and somebody else would take over the production. So there are models that we could follow."

The third alternative was to make educational software development more attractive to commercial groups by compensating for the amount of revenue they lose on individual programs due to software copying. Said Professor Grouse, "It is a characteristic of the school environment that software protection legislation is totally ineffective."

Reinfelds added, "This copying business is really very worrying. It could be got rid of simply by the education department buying software in bulk; because after all, the education department to a large extent determines what will be bought and what won't be bought. It's a political question anyway. So they may as well buy the thing in bulk, and let the schools copy freely within schools."

"Or, buy a licence," suggested Grouse.

"Yes, but a big one," said Reinfelds, "so the developer has enough money available to do a proper job of developing and testing and packaging the product, or it will remain a cottage industry."

Hughes reinforced the need for such a move by saying, "While educational software is seen as a profit area where you can sell things individually to individual teachers in schools, there's going to be a colossal amount of junk around. When some quality control is exercised, when perhaps the very best of the stuff is bought by the system, by the department, then teachers will have something better to work with."

> ***"There is little incentive for the people with the skill to write expert systems . . . to provide them for schools."***

Literacy or Proficiency? – Computers in Society?

We then discussed *whether schools should aim to teach computer literacy or computer proficiency; and whether it was undesirable to approach the latter without also emphasising the broader social issues.*

According to Professor Reinfelds, "There are three things you can teach: one is computer science; another is computer awareness and application of computers, for people who want to know what computers do and how they work, but not necessarily how to build one; and thirdly one can teach these things called The Impact of Computers in Society.

"It seems to me that the impact of computers in society should be discussed in the tea room, because we don't teach physics in society, we don't teach maths in society, we don't teach chemistry in society. So what's so special about computers in society – they're just another one of these gadgets?

"Computer science, as such, is a very special subject; and the big debate in university computing science at the moment is whether one should teach computer science in high school – that is, how to program, how to develop, how to design, how to construct a program for a computer – or how to use the program. That is, how to take a very sophisticated program product and apply it to something – to physics, to daily life, to whatever it is made for. This last is quite a difficult proposition.

"I feel the teaching should be somewhere in the middle: we should teach people the basic principles, in the same way we teach physics and chemistry. Students should be able to read and understand a program and know which is a good program and which is a bad one. They should be able to understand the problem solving process, but not necessarily be very proficient at actually constructing programs or computers?

John Hughes had a slightly different point of view: "I agree on the matter of computers in society. I think if you're going to tackle that area, it should be in a social sciences course as part of the discussion of all sorts of things in society.

Tools for Problem Solving

"I'd like to see the computer introduced in schools first as a tool. Fundamentally that's what a computer is. It is something that we use to help us with some form of problem solving. If draftsmen are going to use computers in computer-aided design, then let's introduce that concept into our technical drawing and those sorts of courses. If economists are going to use it as a modelling tool, then let's introduce econometric models. If accountants use spreadsheets, then let's introduce them. I think that's the place that I would first like to see computers introduced in schools – as sensible tools in the application areas of other subjects.

"Having said that, I believe that if we are going to introduce computer studies or computer science as a discipline, then we should do it properly and not in a half-hearted way. And I think it's as acceptable a discipline in the senior secondary school as many other things are. But I believe that it should be properly thought out. It should bear in mind everything that's been learnt in the last 20 years about computer science – and it has become a science more

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than an art in 20 years. But I'm afraid that because of the hardware and because of the nature of the training of the people who are teaching high school students now, it is being taught rather like it was in the late 1950s and early 1960s."

Professor Grouse brought the discussion right down to basics when he interjected with, "I think we've got to look more at what's happening now. What are they doing? They hit the kids with a popular micro, they give them a book on BASIC, or the kids find out about it for themselves. So the kids are learning to program in BASIC, they're swapping computer games, of course, and they'll run the odd interesting educational program. But I must say one of the most useful skills they are getting now – and it's not the one they're trying to get – is keyboard handling. They can get their little fingers into the right places on the keys. And that is a fundamental skill."

While some subsequent remarks disputed the value of teaching keyboard skills, claiming other input methods such as the mouse and microphones would make typing unnecessary, the conclusion was that it would be a great many years before alternative input methods are sophisticated or fast enough to oust QWERTY. "However," added Hughes, "I do think if we're going to spend a lot of time, especially in the junior area, teaching keyboard skills, we ought to bear in mind that most of what is being done for the human-computer interface at the moment is to get away from using keyboards and to use much friendlier and easier forms of communication."

When Should Children Start?

We then asked, *Assuming many children will only have contact with computers at school, and given the restrictions that limited education funding imposes, what would be a practical age level at which to introduce computers to schools?*

John Hughes: "I think they should be introduced at the earliest stage at which the student is likely to encounter computers outside school. As far as I can see, that's almost as soon as they start school. Certainly five-year-olds have concepts of computers and what they can do which are significantly more advanced that what I know some seventeen-year-olds have."

The conversation then turned to a discussion of how young children like dealing with concrete objects. The general opinion was that while children could certainly be introduced to computers at an early age, the methods should be related to concrete objects rather than abstract manipulation. Using the Logo programming language to drive 'turtles' was given as an example of how children can interact with and learn about computers, and get concrete results.

Professor Reinfelds explained:

"Logo is a language invented by Seymour Papert for use by very young children in primary school and pre-school. It involves very simple concepts and it makes the program concrete by using either a mechanical device, known as a turtle, or a triangle on the screen. The language consists of commands to the turtle to carry out actions. The turtle has a snout so it faces in some sort of direction, and one can give commands to the turtle to go forward a certain distance, say 100 units. One can also tell the turtle to turn through some degrees. The turtle has a pen inside and one can tell the turtle to drop its pen or to lift its pen. If it lifts its pen it leaves no trace; if it drops its pen, it leaves a mark. Using these concepts, one can build an instruction sequence telling the turtle to move forward, to turn right by 90 degrees and move forward, turn right 90 degrees and move forward, turn right 90 degrees and close the figure. One can store the sequence away by giving it a name, calling it a square, and draw further, and so on. And that is the Logo language."

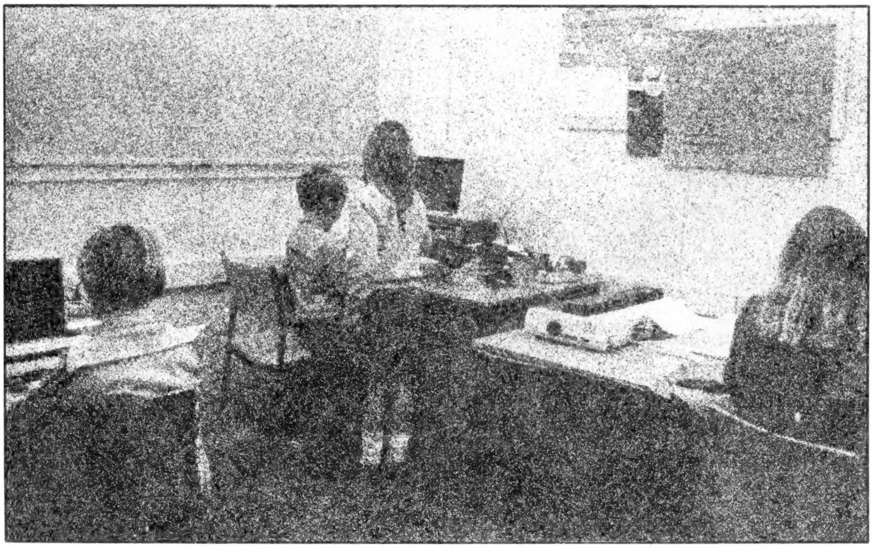
Venturing into Mainframes

Taking this to the other extreme, we asked, *Should children of high school age be taught about mainframe computers, or should the mainframe world be treated in tertiary institutions?*

"I think you've got to tell children about diseases and the effect of smoking and mainframes and things like that," said Grouse.

More seriously, Professor Reinfelds proposed that a mainframe is no different from any other computer, "A mainframe just happens to be a very large, very expensive computer system."

Professor Grouse drew attention to the 'sharing' aspect of larger computer systems: "I'd prefer to see a distinction between shared systems and individual systems. I'd also like to see students familiar with systems such as Midas – database retrieval systems – which can only be done, not just with a single mainframe, but networks of them sharing gigabytes ... terrabytes



of mass memory. It can't be done on a micro – today. It's not so much the larger systems' ability to store masses of information and retrieve it very quickly, but the fact is that if you've got a system like Midas, it has to be centralised. You have to have one depository where all this information can be fed in and people can read directly out of it, rather than distributing it all on a billion floppy disks every five minutes. In that sense it makes a lot of good sense. I would think there'd be some educational value in schools from time to time logging onto Midas."

> ***"They can get their little fingers into the right places on the keys. And that's a fundamental skill."***

To Network or Not to Network?

The discussion then veered toward the merits of networking computers in and between schools. Said Phil Grouse, "One school I have been associated with is dead keen to go network, without necessarily understanding just what that means. The teachers believe and they have read in the literature that networking, sharing resources, is the thing to do. I'm not saying that's not the way to go, but I think they are listening more to the advertising."

John Hughes explained the two levels of networking likely to be used in schools, "Talking about a local area network to maximise the use of some resources is one thing. Within a school for example, you might use networking to share a hard disk. That may be cheaper than other storage options. I think there is an advantage in pooling resources for maximum cost effectiveness. If it's more cost effective to put in an LAN with access to these resources, then that's fine.

"The other concept is of course the broader one where you want to communicate with other people in other areas. In a way that's the Tasmanian model. At the moment, I couldn't see the justification for that larger network in New South Wales, although Tasmania uses it quite effectively because every school there has access to the network. They use it to distribute software. They use it to send out system changes. They use it as an electronic mail system. I think in most other states it's a matter of waiting and seeing what happens in terms of larger-scale networking, but networking within schools should be considered."

John Barrett said he'd like to see larger-scale networking used with disadvantaged schools and isolated students in rural areas, and mentioned satellite links as a means of implementing this.

...LISTEN DEAREST..."SCHOOLS ON A SMALL BUDGIE STILL MAKE USE OF COMPUTERS..."
OH
BUDGET, SWEETEST...
RATHER CRUEL, DON'T YOU THINK.?

Software on the Radio

An alternative method to broadcasting software and so on, using satellite communication, was being investigated in the Blue Mountains, said Professor Grouse. "They are considering the possibility of using an FM transmitter to broadcast masses of educational software which is in the public domain. It is transmitted as an audio tone on the audio bandwidth and students can record it on cassettes."

Professor Reinfelds finished by saying, "I don't see much point in pushing statewide networking for a large state like New South Wales. In Tasmania the situation is quite different because there is a focal point called the Elizabeth Computer Centre in Hobart. This is a resource centre which develops software and which schools can contact, through the network, to say 'Hey, what's going on? This doesn't work. How do I fix it? What do I do?'

"In New South Wales we have no such resource centre, and that's one of the reasons why we are so backward. The education department just talks about this, that and whatnot, and has not yet produced such a centre as Tasmania and South Australia have. So we don't really, at the moment, have the need to connect all the schools together.

"Locally, I think there is a much better case for a network in the same room. An application for networks in the classroom which hasn't been mentioned yet is that a teacher may want to write a laboratory class, like language laboratories run now, with which he or she would control all the terminals. This would allow the teacher to check that all students were progressing with their work. We have 30 Macintoshes in our first year laboratory and it's quite difficult for a teacher to run around and see that all 30 students do what they've been told to do."

A Computer in the Home?

In response to the question, *Do children get enough contact with computers in school, and should parents be looking at buying their children computers to augment what schools can provide?*, we got what amounts to some good news and some bad news.

Professor Grouse said, "Maybe in a few years there'll be enough computers for kids to use in school, but in the immediate future the answer is generally no. The fortunate schools now have maybe a dozen or two dozen machines. Many schools have only one, and they think they're well off. Now it gets very crowded when you've got 100 pairs of hands trying to get onto one keyboard – it doesn't work. Even two dozen is very difficult, because it isolates those students who manage to get onto the computer from those who can't. Then you get these computer clubs forming at school, of kids who've managed to get onto the computer first and found out how to use them. It becomes a polarisation. Ideally there should be a keyboard for every

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Chaos or Coherence?

student in a class, and I think a dozen or so in the average high school is too few. This takes us back to money.

"As far as a child having one at home is concerned, if computers are missing at school, then maybe that's the way around it. But it's not going to be of any value unless the teachers know what it's all about so they can guide the kids in what they do at home – and most teachers can't.

"What worries me is the child whose parents cannot afford a computer, who is therefore disadvantaged because somebody else can. It hasn't quite got to the stage where the cost of a computer is the cost of a calculator.

They Won't be Deprived

According to John Barrett, "Children are certainly not deprived by not having a computer. They're also not going to miss out on future occupations because they don't have a home computer. There's been a lot of rubbish in the advertising of computers which has tried to frighten people. Instead of this scare-tactics approach, I simply ask people if they can afford a few hundred dollars to go out and buy one of the cheaper small computers and play with it. I think most people like tinkering and there's a lot of fun in that. But they shouldn't have great expectations and shouldn't go in at the expensive end of the market. You can play with a computer, it's an active sort of thing. You can have all kinds of experiences with it and get as much as you can out of it. I'd encourage people to go ahead if they're not going to put their house on the line to buy it."

The suggestion was also made that if a child had a computer and only used it for playing games, he or she might never learn any more about it than where the cursor control keys are. Some argued that such pursuits were no more expensive and no more harmful than the now traditional and often chronic pastime of watching television – not a very constructive comment, but it is food for thought.

Funding for educational software development surfaced again at this point when John Barrett said, "If instructional material were anywhere near the quality of some of these games, in terms of simulations and interest-generating capacity, it would be wonderful."

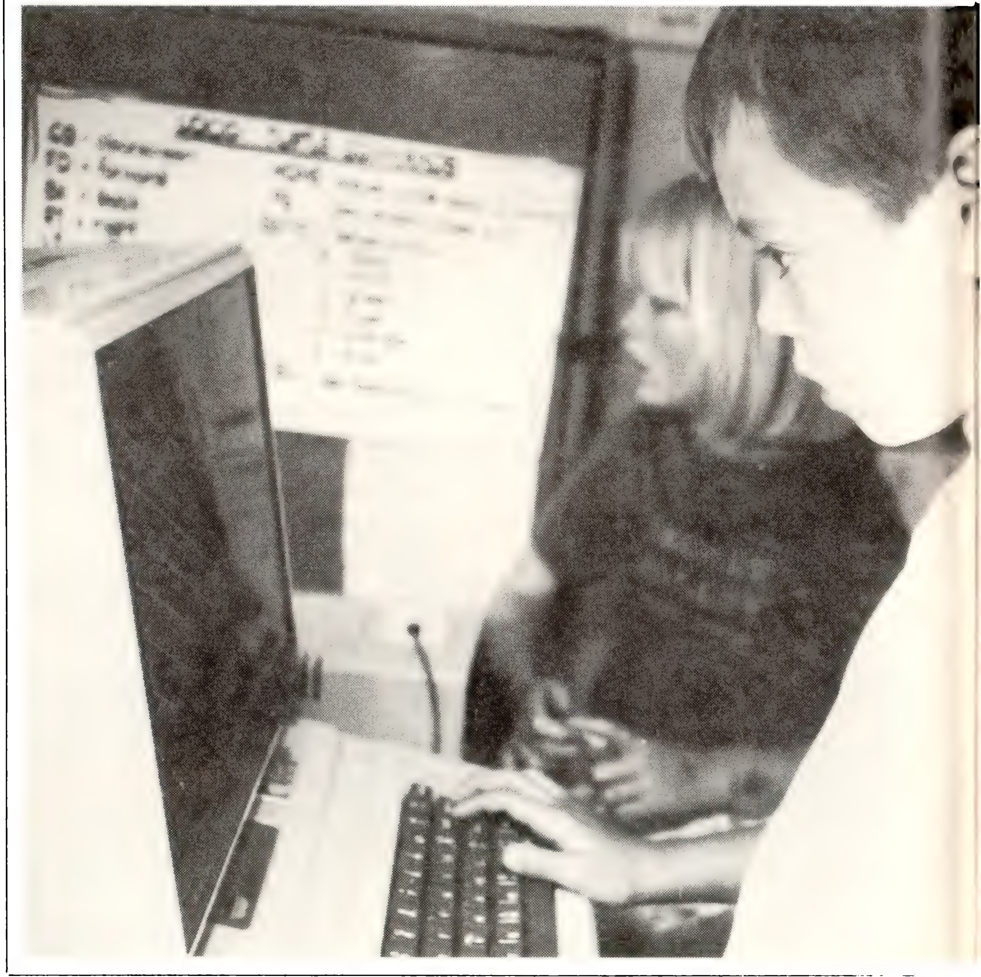
"That goes back to the same issue," commented Grouse. "The incentive for the software writer to generate educational software with that quality of graphics and sound and response is just not there. And that's a government policy issue."

Are the Uni Courses OK?

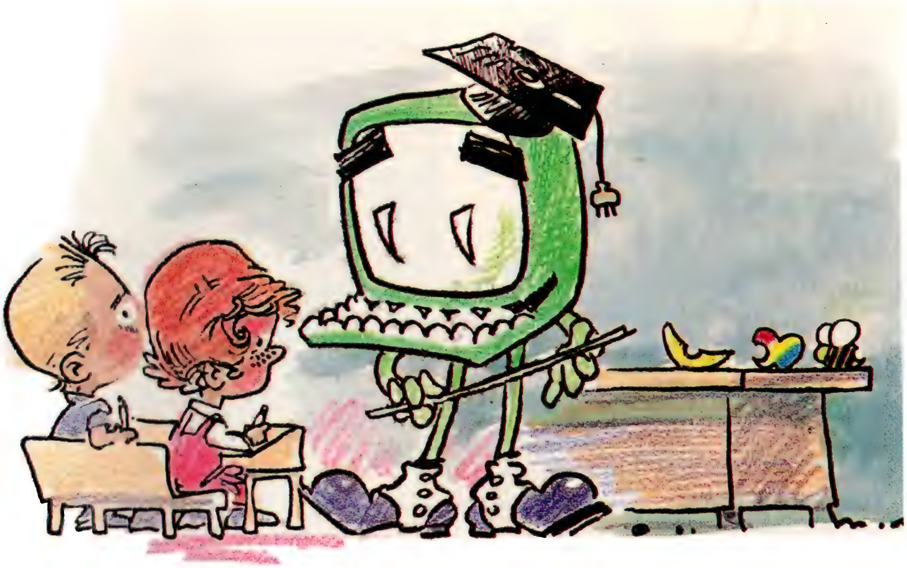
The next question was a ticklish one to ask of the assembled company: *Are current tertiary computer-oriented courses adequate?* The responses were surprisingly objective, the debate lengthy. But it is worth repeating, almost in its entirety, because of the insight it gives into how education works from the educator's point of view.

Professor Grouse: "Every man now does what is right in his own sight. We've had to. You see, physics has always taught its computing in its own way, for example. Mathematics at the University of New South Wales, for heaven knows what reason, has always taught FORTRAN, which I think today is found only on the side of tombs. Then again there is another peculiar breed of people which seems to be only able to speak a language called Pascal. And at the other extreme, there's the BASIC crowd."

John Hughes: "In our institution (New South Wales Institute of Technology) everybody, I think, with the exception of those in the humanities, would do a computing course. That includes law and all the sciences, engineering and architecture.



And the humanities people do encounter it a little; I give a couple of lectures to all the first-year humanities students. So computers play a fairly large part in tertiary studies. I think it's getting to be rare where a student could go through tertiary education without encountering something to do with computers. Whether what they encounter is good, appropriate or anything else is of course another question because, as Phil said, nearly everybody teaches their own way.



Cyclical System

"We go through cycles. In the past at the Institute computing science teachers taught virtually everybody about computers. So, in other words, we go through cycles where we teach engineering students computing; then engineering decides that it's more appropriate for them to do it; and now we're just about to go back into the second phase of this, where they're now saying they'd like to involve us because what's happened is computing's changed since the engineers took it over, and they're not necessarily up with what's happened since 1967-68. What they need is another refresher course and then in a couple of years' time they'll take it back again – until something else happens.

Professor Reinfelds: "That's an idealist speaking. What really happened was that staff ceilings were put on and larger student numbers no longer bring new positions, so they unload the students onto you."

John Hughes: "If you look around at the number of teacher education courses and you look at the number of people qualified to teach these courses, there's not a one-for-one correspondence. Before we train the teachers in computing, I think we'd better train the people who are going to train the teachers and those things don't seem to have been addressed at all.

So, ... *Are tertiary-level computing courses adequate?*

Said Professor Reinfelds, "I can only speak for the universities and I think by and large we must agree that the university courses in computing science are adequate. At least I don't see any way in which to change them today, because if I did I would have done so. We review the curricula in almost all universities at least every three years. And they change and evolve by themselves as much as is possible with staff which is extremely overloaded with huge student numbers, no resources and no space."

In Non-Computer Subjects?

Grouse: "But Juris, what you're talking about is computer science, which is only one aspect of computer education at the tertiary level. We've been talking about the other faculties which are involved in this and from what one reads and what one hears, it would seem there is still a great deal lacking in those non-computer-science faculties in schools and the manner in which they are proceeding about their education in computing."

Reinfelds: "Oh, you mean to say there are computer-oriented courses in other areas of the university? I don't think that little bit of FORTRAN the mathematician learns is really much of a course, it's just a fraction of a subject. In Wollongong it's one-sixth or so of a quarter of the first year."

Grouse: "Sure, but the computing follows them through year after year. They are given a book on FORTRAN, or whatever the language happens to be, in the first year, and it follows them through and they're expected to make use of the computer. They are given computer assignments. In the School of Accountancy at the University of New South Wales, students are expected to consume vast amounts of mainframe time, doing exercises in straight programming, running simulators, financial

Chaos or Coherence?

modelling packages and the like. And it would have to be said that the folk who are involved in teaching are essentially accountants, economists, financial experts, who have managed to learn about computing by dint of the fact that it's been necessary for them just to keep abreast. They are not computer science specialists, and I think what you're saying is that this is a problem. They are teaching a subject which is not their discipline, but part of it. And I would think that's an area where we should be addressing the need of teacher education. We are not teaching effectively those teachers whose responsibility it is to teach computing aspects of their own peculiar discipline."

Cutting up the Pie

Reinfelds: "I agree with you completely, and I think John said this too, that those things should be focussed in the computer science department. That's a big political problem in this place where people have territorial instincts. A university is just not one university, it's a fiefdom of assorted counties, and the dukes, namely the department heads, fight it out on black horses. It doesn't matter how big the common pie is in the university as long as my slice is bigger than yours. And as long as this prevails there's no way we can steer enough resources in the direction of computing science, even if we could find the people, which is difficult at the moment because we don't train enough. We don't train enough PhDs, we don't train enough MScs, for the country's needs. But even if we had the people, or we could bring them in from overseas, it is very difficult to see how resources can be steered in the direction of computing science departments quickly enough to satisfy this particular need, and whether the academic colleagues will be happy with a proportionally smaller cut of the pie. Professor Bennett from Sydney has been working on this an awful lot in the last few years and I think the main idea we have is that the only way we can do it is if the government puts earmarked grants into the universities for computing science. Otherwise there's no way. There's no way to have a democratic committee vote itself out of existence."

Computing on a Small Budget

Our final question was, *How can schools on a small budget still make use of computers to benefit the students?*

John Hughes began: "Let's assume that having a small budget means the school can afford one computer – and that probably reflects the reality in the majority of Australian schools. How can a teacher use that computer effectively in school? I think that unless there is more money spent and we get more equipment in, we'll never get the computer down from its 'in case of emergency break glass' position, where it sits and nobody is ever allowed to touch it for fear of damaging something."

Professor Grouse: "Or the teacher takes it home in order to improve his computing skills so that he'll be a more effective teacher.

"It must be multiple keyboards. You're looking at a minimum of a couple of dozen, in a classroom set-up, for people be able to use at lunchtime or in special classes. You just need the volume; and they should all be the same computers, too."

John Barrett: "I think even if you had eight it might be enough. Many of the computer literacy-type things can be done without a computer. It's not the best way, but ... The other way is to get children to bring their own computers to school. That's been done. Microbees are good for this because you can transport them fairly easily.

"Another way might be to put six or eight cheap computers in the school library. But really all these ideas are not solving the problem. We're really talking about the need for a computer classroom as such."

John Hughes: "I think if you're talking about a primary school environment, then you probably could, within a classroom, still make effective use of one computer. My understanding in the infants and primary classrooms is that very much of the work is activity-based, and often children rotate around activities and so on. But it would be a fairly small percentage of the curriculum that you'd be able to cover that way.

"In the secondary school I think one computer would be limited to being a teacher's aid, like an electronic blackboard the teacher could bring in, perhaps to demonstrate a concept that otherwise couldn't be done very well. I mean I sat through years of physics at university and I'm quite sure a computer could have done a better job of getting across those concepts. So teachers would have to think of that one computer as an interactive visual aid. I would have thought it could be used in virtually any subject: in geography, in physics and chemistry, in mathematics and so on."

Phil Grouse: "A good teacher with a bit of imagination could really do wonders with just one computer and a big monitor up there – even just demonstrating a spreadsheet. You could even teach them infinite series with a spreadsheet; you could compute e to the x with it."

So, the topic again scrolled to money: the lack of it.

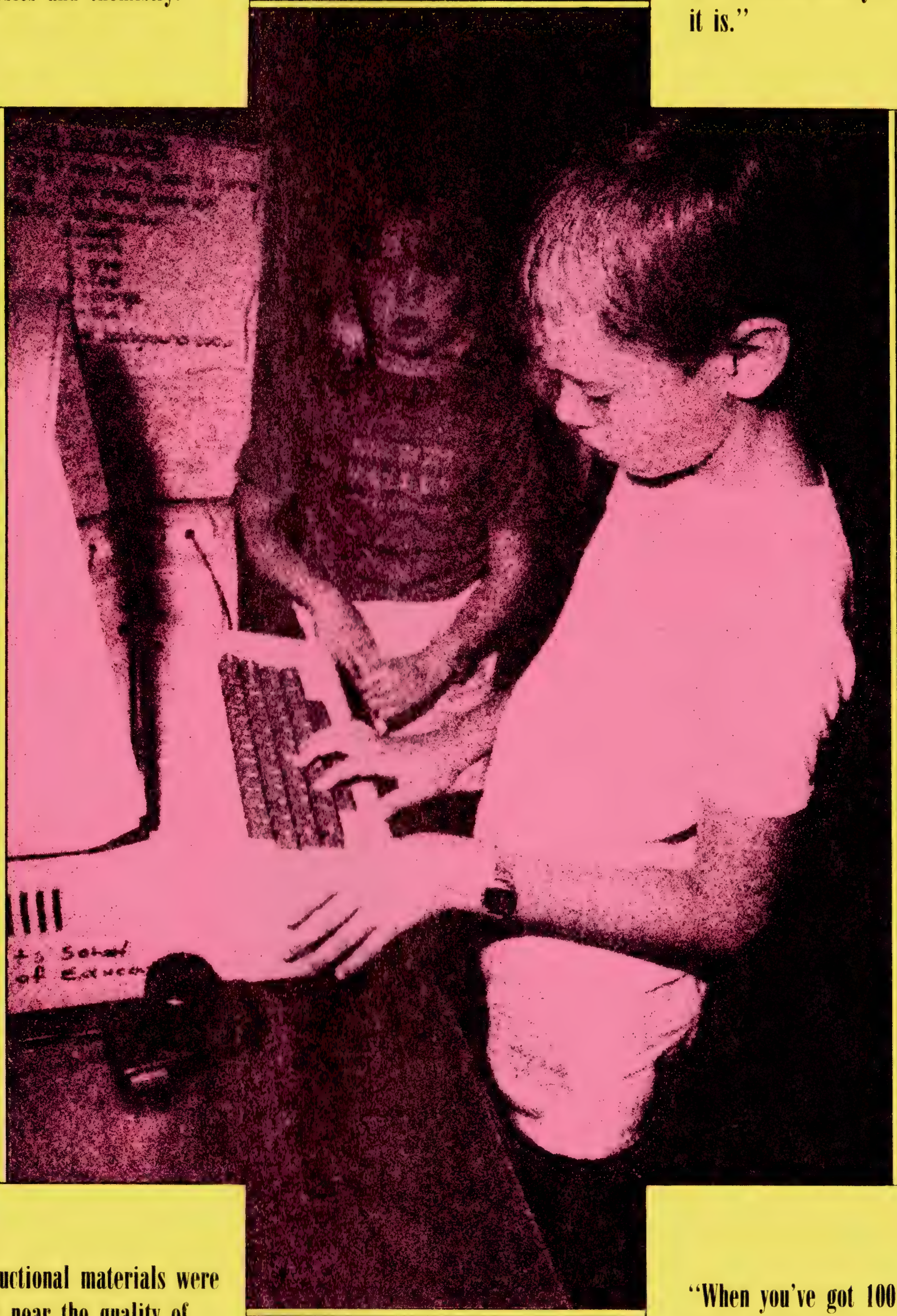
Help from Manufacturers

Said Phil Grouse, "Funds are lacking; however, there is a bright light on the horizon. Many of the computer companies are very keen to address that need. I know of a number of computer companies who are very keen to hand over hardware, no doubt with some form of string attached. The idea behind their offers is both for the students to have the benefits of the hardware, and for them to be impressed with that hardware so when they leave school it will stick in their minds and they will eventually buy the same brand for themselves or their businesses. I think that sort of offer should be recognised for what it's worth to the schools"

John Barrett's final comment was disturbing: "One of the things I'm concerned about is the distribution of the funds that *are* available across Australia to a whole number of schools and a whole number of people. By the time you carry out an analysis of that later on, you'll probably find that much of the money is being spent on transporting people to meetings." ■

“We should teach the basic principles, in the same way we teach physics and chemistry.”

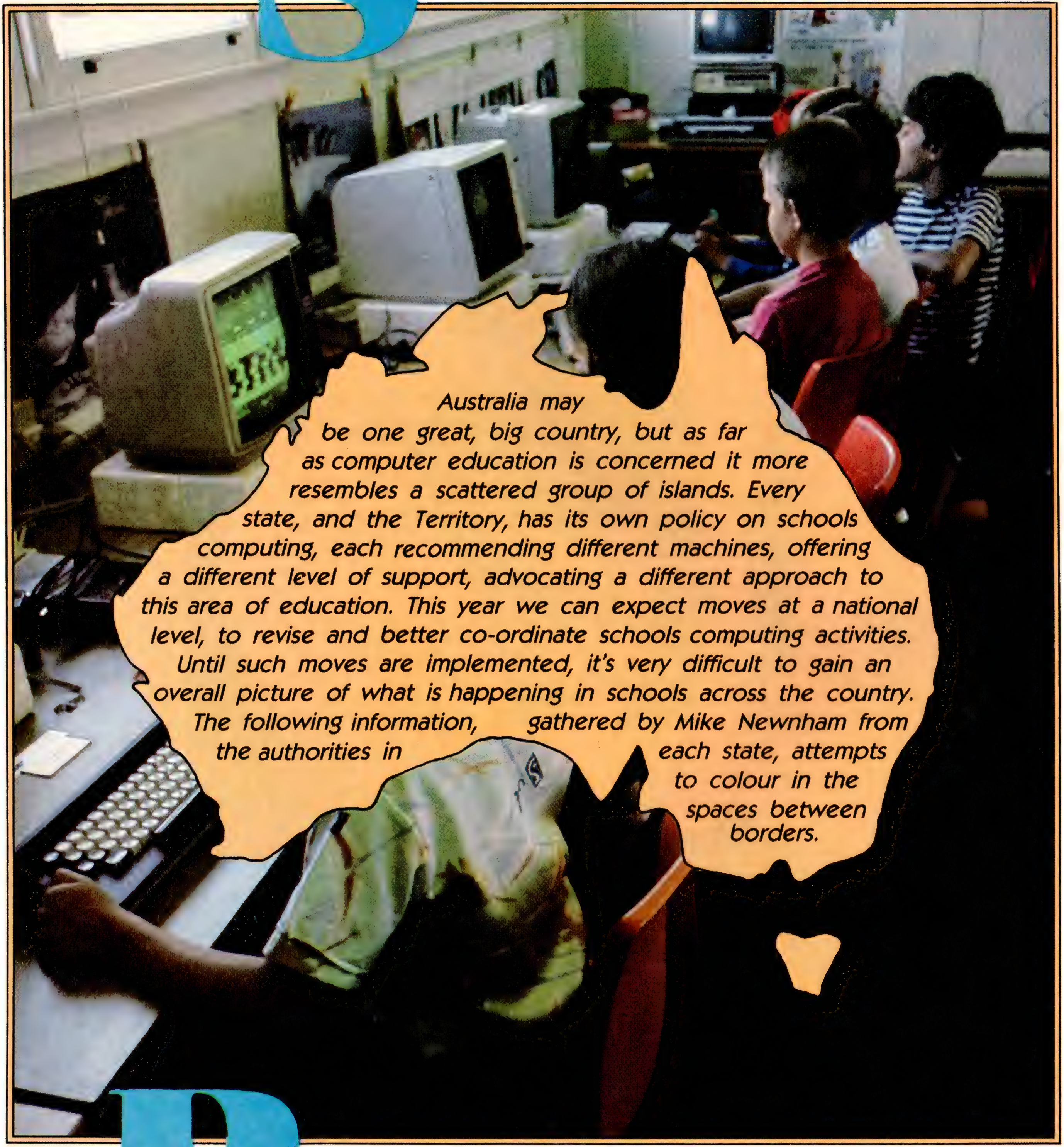
“I’d like to see the computer introduced in schools first as a tool. Fundamentally, that’s what it is.”



“If instructional materials were anywhere near the quality of these games . . . it would be wonderful.”

“When you’ve got 100 pairs of hands trying to get onto one keyboard — it doesn’t work.”

State Round-up



Australia may be one great, big country, but as far as computer education is concerned it more resembles a scattered group of islands. Every state, and the Territory, has its own policy on schools computing, each recommending different machines, offering a different level of support, advocating a different approach to this area of education. This year we can expect moves at a national level, to revise and better co-ordinate schools computing activities. Until such moves are implemented, it's very difficult to gain an overall picture of what is happening in schools across the country. The following information, gathered by Mike Newnham from the authorities in each state, attempts to colour in the spaces between borders.

New South Wales

The New South Wales Department of Education policy on schools computing is divided into three categories:

- Learning about computers and computing.
- Using computers for learning.
- Using computers for management.

The policy statement puts forward the view that "learning about computers is a developmental area of study which has a place at all stages and in all areas of computing", and that it should be a part of the schooling of all students and of the professional development of all teachers.

The policy defines minimum goals for learning about computers and computing. These involve creating "an awareness of the implications of computers for the individual and society". It is also advised that students should learn how the computer can be used as a tool for investigation and discovery, and learn of the flexibility of its application.

Practical experience, according to the policy, should be gained through the use of appropriate programs, to discover the computer's value for problem solving. And an understanding should be gained of the nature of the computer program, which would not necessarily involve learning programming.

On 'learning with computers' the policy makes a number of points dealing with the positive impact the computer can have on the learning process.

The computer, it says, can improve the effectiveness of existing teaching/learning processes, and may introduce new approaches and methods.

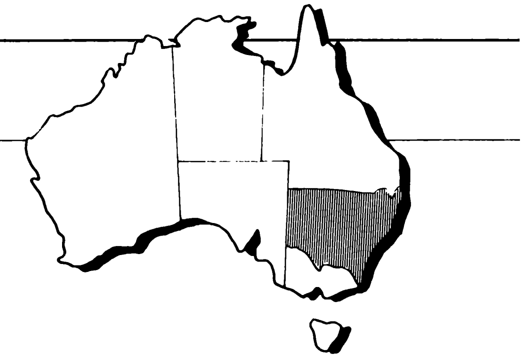
It is also advised that different learning styles among students be allowed to develop, and that the imposition "of a uniform computer-based approach on all students" be avoided. Hence schools are encouraged to investigate new techniques that will enhance the students' learning experience.

Using computers for management is an area of schools computing where the policy counsels caution. Schools must "evaluate carefully the resources needed to implement new procedures against the likely savings and other benefits, keeping in mind that the prime purpose of using computers in schools should be an educational one."

Priorities

Learning about computers is described as more important than using them as teaching or learning aids, which, in turn, has more importance than their application to administration.

Activities promoting computer awareness are given greater emphasis than specialised elective courses. And Years 7-9 are destined to receive greater attention than other areas of primary or secondary school.



Implementation

The department provides support to schools purchasing equipment for the first two categories of computer use mentioned in its policy.

The Computer Education Unit co-ordinates activities involving curriculum development, the development, evaluation and distribution of software, and other non-hardware resources. It also provides for the in-service, professional training of teachers, and advises on equipment selection.

At this time there is a shortage of suitable software and a shortage of computers actually in schools – the number of micros in NSW schools is around 2200.

Courses in computer-related subjects have been approved for Years 7-10 and Years 11-12. Secondary schools currently represent the bulk of computing activity, however primary schools are becoming more involved.

Computers may be acquired by schools through the Annual Requisitions Scheme, which applies only to those computers on government contract. These are the Microbee, Atari, Apple II, BBC Micro and IBM-PC. ☐

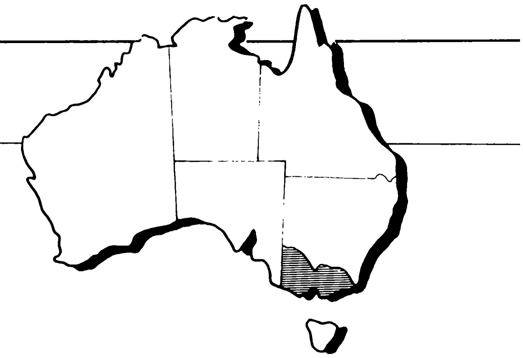
Victoria

The Victorian Education Department released its policy statement on computers in schools in October 1983. Since then, twelve regional computer education resource centres have been established throughout the state, recommendations have been made on suitable computer systems for schools, the Department has begun a software evaluation programme, a state computer education centre, providing a "centre of expertise", is in the final stages of development, and the majority of Victorian schools are utilising computers in some way.

The state's twelve regional resource centres provide the venue, equipment, software, materials and personnel to cater for a programme of teacher professional development. They also offer curriculum materials, advice, and information on strategies and activities for ensuring equal opportunity in the use of computers in schools.

Systems Rationale

The Education Department's recommendations on computer equipment were released in March 1984, and are due for review at the same time



this year. The three systems currently recommended, and supplied through contracts with manufacturers at significantly discounted prices, were chosen to fill the needs of three specific levels of schooling:

1. The Commodore 64 was chosen as a system which "would offer Primary and Post Primary schools

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Victoria

continued

the opportunity of purchasing a low-cost starter system which could be readily dedicated to a number of educationally sound computing activities." It was found to allow the use of "programs aimed at increasing computer awareness, and introducing the computer as a resource across several curriculum areas."

The 'Single-User Commodore C64 Victorian Education Package' consists of the computer/keyboard, a monitor, a disk drive, and copies of Logo (to develop computer awareness, and programming and problem-solving skills), 'Word/Name Machine' (a text editing package) and Easyscript for more complex word processing – for $1058.

2. The second system, the Apple IIe, was selected on the basis that it "would satisfy a much wider range of curriculum needs than the first, particularly at post primary levels." It filled the criterion of being able to run a wide range of software, thus enabling it to be used effectively in most curriculum areas. It also provides "sufficient power and versatility to cater for the needs of Computer Science and Computer Studies classes," and is sold to schools in a configuration similar to that of the Commodore package.

3. The third system was to cater primarily for the larger post-primary school with a curriculum emphasis on computer science, data processing, business studies and commerce. The Pulsar 6000 was chosen here, since it offered, among other features, "greater capacity relative to the other recommended systems, and was also seen as appropriate for some administrative applications."

All the systems mentioned are available from the State Computer Education Centre in both single- and multi-user packages, the latter including networking equipment. Printers are also included in the recommendations, and offered at discount prices. Only limited funding is available to assist schools in purchasing computers.

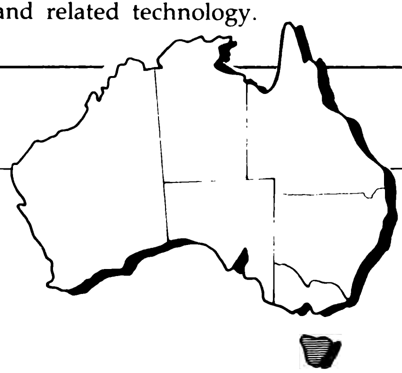
A Centre of Expertise

The State Centre, which should be fully established this year, represents the work of a 'Computer Education Task Force', whose projects have included: curriculum development, software development, software evaluation, software and information distribution, in-service programmes and ongoing hardware evaluation. The Task Force is to be modified and absorbed into the centre, and will also be used to make future policy recommendations.

Under the still current 1983 policy the Victorian Education Department states that it supports:

- The use of computers to enhance and promote the learning process.
- Creation of an awareness and understanding of the capabilities and role of computer in society.
- The study of 'Computer Science' and related technology. □

Tasmania



At the time of writing this article, the Tasmanian Education Department had only a draft policy on 'The Classroom Use of Computers in Primary Schools', yet Tasmania has long been recognised as one of the most advanced states in terms of actually using computers at both primary and tertiary levels. The developers of the Tasmanian schools computing system are heralded as authorities in the field, and many innovative educational software packages and approaches to classroom computing have had their origins in Australia's southernmost state.

Since 1975, schools computing in Tasmania has been co-ordinated from the Elizabethan Computing Centre. Staff at the centre are involved in software design and production, consulting on curriculum development, the production of support materials and extensive teacher training.

TASNET, a minicomputer network to which all secondary schools, colleges and administrative centres in Tasmania are connected was also established in 1975. In addition, there are in excess of 700 microcomputers in Tasmanian schools.

The system recommended for primary school computing is the BBC Micro, while in secondary schools both the BBC and the Apple II are supported.

Schools are responsible for the purchase of their own hardware, but software support is provided by the ECC and a maintenance programme is operated for approved systems by the Tasmanian Media Centre.

In-service Service

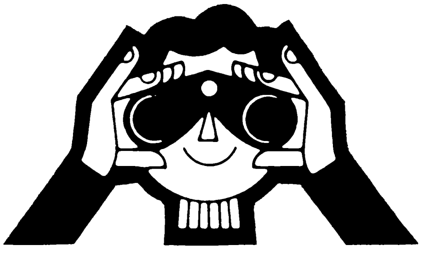
Extended teacher training programmes exist, and in 1983 approximately one third of teachers received in-service training in one of the following forms:

- Formal accredited in-service course provided to enable a teacher to upgrade his or her Diploma of Education to a Bachelor of Education degree, and involving some 70 hours of attendance by the teacher.
- Special-purpose block release schemes which free teachers from classes for a short time to enable them to attend specific short courses.
- In-service seminars, generally involving the entire staff of a school in a general introduction to educational computing.

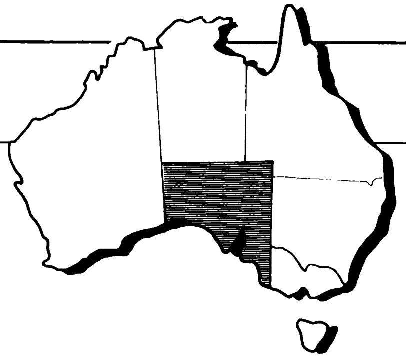
In the schools themselves there is a general emphasis on computer-assisted learning, evolving from drill and practice techniques and progressing to simulations, information retrieval packages and software which is designed to extend the thinking and learning processes.

Three computer literacy courses have been developed by the Elizabeth Computing Centre, and Year 9 and 10 students may take Computer Studies as a formal subject in secondary schools. □

State Roundup



South Australia



South Australia is one of the three states (the others are Western Australia and Tasmania) in which schools computing got an early start and is now at the point of consolidating and revising well-laid early plans.

The state's education department has a central computing centre at Angle Park, the staff of which is responsible for development, co-ordination and support of computing services. The centre houses ten Apple II computers operating on an Omninet local area network , and 20 BBC Micros on an Econet LAN. Government schools have access to these systems via further networking (a facility which around 30 schools have taken advantage of to date), and a batch card input system allows students to try out their own programs without tying up expensive and scarce memory time.

The department also provides comprehensive inservice training programs for secondary teachers, along with an expanding scheme for primary schools.

A number of computer-related courses have been included in the school curriculum: a computer awareness course is provided for Years 8 to 10; a computer studies course has been prepared for students in Years 11 and 12; and special computing courses for students showing a particular aptitude and interest are being established.

A programme is also underway to develop techniques to assist children with impaired learning abilities. Already a microcomputer has been developed by the special education section of the department, for use by severely handicapped children.

Concern Over Girls

The Angle Park Computing Centre recently conducted a special project to investigate the way girls were reacting to computers. The aim was to "affect the participation and performance of girls and women in the area of schools computing through:

- Investigation of factors affecting their participation in schools computing programs.
- Raising awareness of the differential outcomes of schools computing programs for girls and boys.
- Identifying strategies that will assist in the equalisation of these outcomes.
- Developing recommendations for future action and directions in the areas of girls and computing."

At this time, each South Australian school is responsible for the purchase of its own computing hardware, and it is estimated that around 95 per cent of primary schools have at least one microcomputer. The Angle Park Computing Centre produces a variety of imaginative software, which it sells to schools for $7.50 per package. □

Western Australia

In Western Australia, the education department has had a Schools Computing Branch since 1977. While in earlier years the use of computers in Western Australian schools was confined mainly to tertiary institutions, the level of support for using computers with secondary students increased steadily, to result in the formulation of a Computing in Secondary Schools policy in late 1980.

In early 1981, pressure from three groups - commercial vendors eager to tap the primary schools market, parents anxious that their children be prepared for life in modern society, and a number of keen teachers - coupled with the increased reliability and decreased cost of microcomputers, prompted the state's education department to prepare a policy for the use of computers in primary schools, which was released in October 1981.

Directors of the Western Australian programme are advocates of the need to constantly evaluate achievements, trends and results in the area of computer education. Thus, they are currently reviewing their previous policies (the revisions are scheduled to be available in 1985), and have also begun a programme entitled WESREV under which all software produced and used by the department is subjected to critical review.

According to Kevan Penter, until recently the education officer with the Western Australian Schools Computing Branch, although the state's two early policies "understate the range, diversity, and magnitude of the educational uses of computers in Western Australian schools," they are still "accurate indicators of overall directions." Hence, we have outlined them briefly below.

Secondary Schools

Computing activities in Western Australian high schools have been concentrated mainly in Years 8 to 10. The rationale behind this is that since approximately 50 per cent of students were known to leave school at the end of Year 10, and since courses in Years 11 and 12 are chosen by students, concentrating computer learning before Year 11 was the most effective means of providing *all* students with a knowledge of computers.

The secondary schools policy originally stated, "all students should be given some awareness of the impact on society of computing and information processing, some awareness of the issues the use of computers raise in society, some experience in communicating with a computer, and some experience in writing programs ▷

State Roundup

Western Australia

to control a computer. In addition, students should experience, first-hand, the uses of the computer as a learning aid in various aspects of their normal school work."

The revised policy will include the development of a range of computing and information processing courses spanning Years 8 to 12, which will include a matriculation-level Computing course. Teachers will also be assisted to upgrade their teaching of computer awareness to the more powerful concept of computer literacy. And the Education department will work towards greater availability of general-purpose software tools such as word processing packages and spelling checkers for English, spreadsheets for mathematics and science, and information retrieval programs (databases) for social studies.

The original policy also outlined what the Education Department had ascertained to be *undesirable* in terms of educational computer usage: "It is not desirable that usage be restricted to mathematics ... It is not desirable that the facilities be utilised during normal class time by a relatively few enthusiasts interested in programming ..." and, "It is not desirable that the facilities be used, during normal class time, for administrative and organisational purposes."

The Primary School Policy

As far as computers in Primary schools are concerned, it was left to each school, and the parents of children attending that school, to decide whether computing was a sufficiently important student activity to justify the commitment of resources to the purchase of a machine.

The policy stated the Education Department would not support the purchase of computers for either administrative purposes or computer-managed learning (in which the computer is used to organise and keep records of individual learning). The use of the computer as an integrated learning resource (CAL), the use of the computer as a motivational device integrated into the educational programme, and the use of the computer to foster problem-solving abilities, were to be given the strongest support. Computer programming activities and computer-assisted instruction (including drill and practise) were to be supported

continued

only to the extent that they could be strongly related to the three most desirable applications mentioned above.

These directives will be extended in the new policy, to include support for Logo-related programming activities, the use of word processing and activities related to information retrieval.

For All Schools

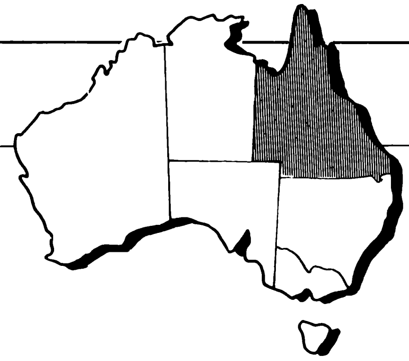
Under the Western Australian schools computing programme, all state primary and secondary schools are eligible for a dollar-for-dollar subsidy on the purchase of approved computer equipment. The Education Department currently recommends the BBC Micro and Microbee computers. The department also undertakes to maintain these approved systems in schools, and provides comprehensive software support for them.

In-service courses are provided for teachers of all subjects and advisory services are available. Developmental work relating to computing and information processing in primary, lower secondary and upper secondary schools has also been carried out.

The state has become renowned for the production of excellent educational software, marketed under the label Wesoft. Development of this software, and many of the in-service courses mentioned previously, take place at the Schools Computing Centre at Nollamara. This centre also provides a source of computing power for schools with dial-up facilities, and contains a terminal room with up to 20 terminals for use by visiting students.

Commenting generally on schools computing in Western Australia, Kevan Penter said, "We as a department are committed to promoting the effective use of computers in schools, but are concerned about the ability of large organisations such as ourselves to keep pace with changes in microcomputer technology. For example, our first published policy on computing in secondary schools was formulated prior to the availability of the Microbee computer, which is now used in great numbers in our schools. The availability of the Microbee, together with 'bundled' software such as WordStar, Multiplan, SpellStar and so on, has of course made a great difference to our approach to computer education. Regular revision of our policy statements will need to be a feature of our approach to computer education." □

Queensland



A 1983 survey of computers in Queensland schools indicated there were in excess of 1,500 computers distributed across 400 Queensland schools. This number has increased considerably, but is still comprised mainly of the computers placed on government contract to schools in that year – the Apple IIe, Microbee, TRS-80, BBC and Tandy Colour Computers.

The Aims

The Queensland Department of Education's policy statement on 'Computers in the Curriculum' also dates from 1983. In this document the Department undertook, among other things:

- To ensure its schools and colleges make appropriate use of computing and associated technology to achieve the recognised aims of educational programmes.
- To promote computer awareness and the development of basic computer skills, with specific approaches to the social and technical impact of computer technology, and the teaching of skills and abilities to help students meet the demands of present and future involvement with computers.
- To incorporate computer-assisted learning into existing programmes, based on the premise that enhanced learning will result.
- To continue to monitor and assess the impact of computers on society, and on the educational process in the state's schools and colleges.
- To establish curriculum guidelines for educational computing in schools and colleges.
- To train teachers by way of in-service programmes.

The Achievements

Some of these aims have been achieved; for example, in March 1984 the Curriculum Services Branch of the Queensland Department of Education published a comprehensive introduction to networking microcomputers in its newsletter, *Computer Download*.

In other areas, such as teacher training, the Department is still in the process of implementing the policy. While some teachers with computer skills have been selected to assist others as part of the in-service programme, the distribution of these people is apparently uneven, causing similar imbalances in the progress of the different geographical regions.

Queensland's educational computing programme is structured on a regional basis – nine regions were defined at the time of writing. Currently, these regions differ also in the financial resources available to them. Since schools are now expected to finance their own computing needs (some funds were available to provide initial equipment for government schools), this again contributes to inequalities in the computer-related education available to students living in different areas. However, the Department has established a supervisory committee to co-ordinate computing activities at a regional level.

Another problem, identified in the March 1984 edition of *Computer Download*, was that the computers in schools and in the general community "represent a resource which is being utilised by only a relatively small percentage of teachers. These teachers tend to have a science or mathematics background, reflecting the historical development of the computer as a calculating or computational device." This is a tendency which prevails from Tasmania to the Northern Territory, and which most states have plans to remedy.

A Computer Education Curriculum Project team is responsible for the development of curriculum material and, where necessary, the revision of existing syllabi to accommodate the involvement of computing. ■

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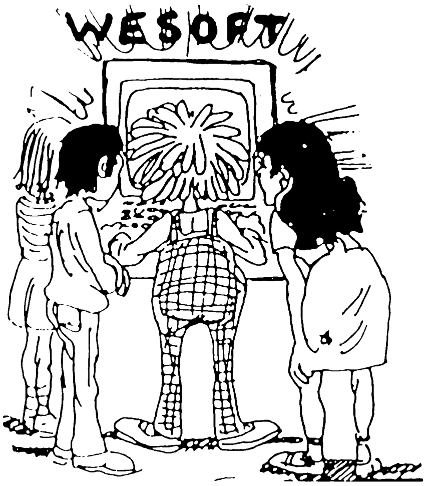

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Choosing a computer for a High School

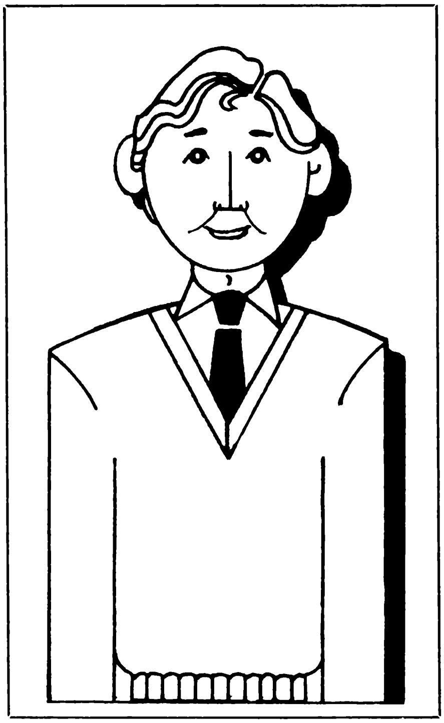
Well, how do you decide which machine to buy in an environment where distinct subject areas, and perhaps even the needs of administration have to be taken into account? Frank Lee stalked the corridors of some of Australia's high schools in search of an answer.

Years back, in the dim dark primeval ages of the dawn of computing as we know it, young Frank found himself confronted with a certain teacher possessed of a fiery zeal for Logic. Not the formal logic of syllogism and inference, mark you. Rather, the pure binary logic of Boole. The logic of True and False. Where Truth is simply a 'bit', and Not is not a commandment, but a unary operator.

The beauty and simplicity of binary logic encompassed my teacher. Determined to share the wonders of the new computer age with his class of Seekers-for-Truth, he convinced the school to shell out the sheckels for a 'Logic Trainer'.

The pupils looked at each other while Mr Logic fiddled with the wires and switches at the front of the room. I recall the breakthrough when he proudly announced the successful debugging of a 'half adder'. This in itself was a questionable achievement, for I recall one pupil's expressed concern over the existence of a 'half' in a binary world populated only by zeros and ones. Ah well.

There was naturally no way he would let any of us young Philistines lay a grubby paw on the shiny new logic trainer. A few of the senior lads were so privileged however (one later became a leading figure in computer science).



And Time Stood Still

Alas, how little times have changed. There are still too many 'One-Apple' schools with shiny-eyed maths masters, and students eager but unable to lay their hands on a Real Keyboard.

Nevertheless, a growing number of high schools with adequate resources have been quick to respond to the demand for multiple-keyboard 'computing laboratories'. This article is addressed to those involved in the provision or enhancement of such facilities. I assume you have both the motivation and reasonable financial resources. Perhaps more valuable than these two assets is the support and interest of a small group of capable and enthusiastic teachers and parents. In this matter, it seems a small, dedicated group will achieve far more than a larger 'committee'. (The camel, of course, was designed by a committee.)

This article is not so much an attempt to provide a specific answer to the question 'Which computer?'. Its purpose is to raise the real issues which each school must address individually.

Speakers at a recent conference of the Computer Education Group of Queensland were generally of the opinion that schools need computers. Now. Schools, of course, agree. If the school has as yet no computing facilities, it wants them. If it already has them, it is talking about enlarging its collection, and/or networking.

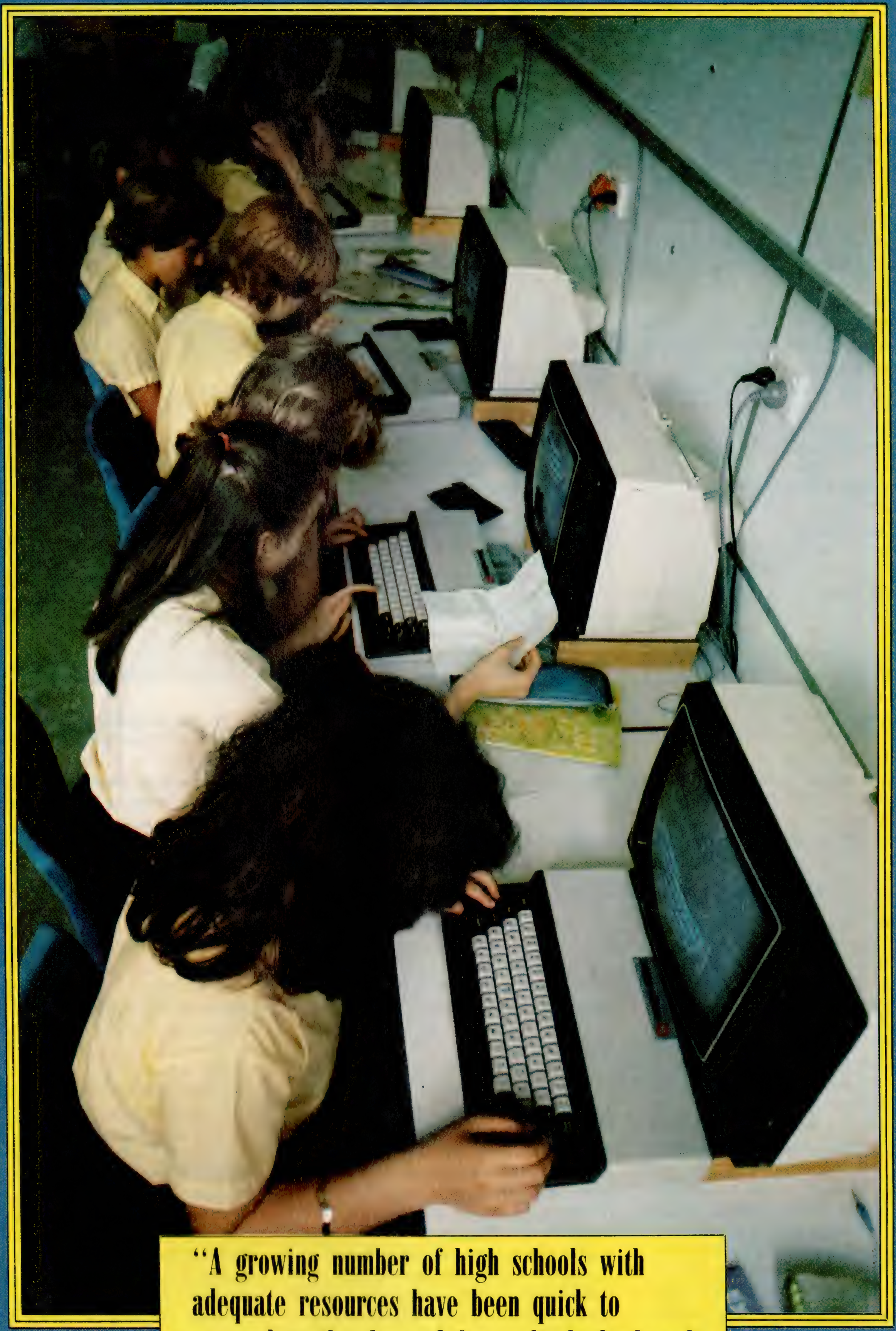
Why Compute?

The important question to consider is not 'Which computer?'. The real question is far more basic. It is 'Why?'.

Don't get me wrong. Sure, you need computers. But what is your motivation? What do you think computers will do for the school?

Do your reasons lie in any of the following:

- We get government subsidisation on computer purchases.
- No child should be without some sort of computer education.
- A computer laboratory would look good in the school prospectus.
- We've been given a grant of $xxx to be spent on computers before the end of the financial year, and it's now June 15.
- When students graduate many ▷



"A growing number of high schools with adequate resources have been quick to respond to the demand for multiple-keyboard 'computer laboratories'."

High School

will be looking for jobs in the new 'information society'.

■ Saint Throckmorton's College has 20 micros, and we're better off than them, so why shouldn't we?

The problem with the above motivations is their sheer generality. In the final analysis, the issue comes right back to educational principles. Are you educating or training? Either way, the school has a curriculum determined by policy and a certain measure of expediency. But when expediency gains at the expense of policy, watch out. Expediency should simply be a measure of flexibility under the guidelines of school policy.

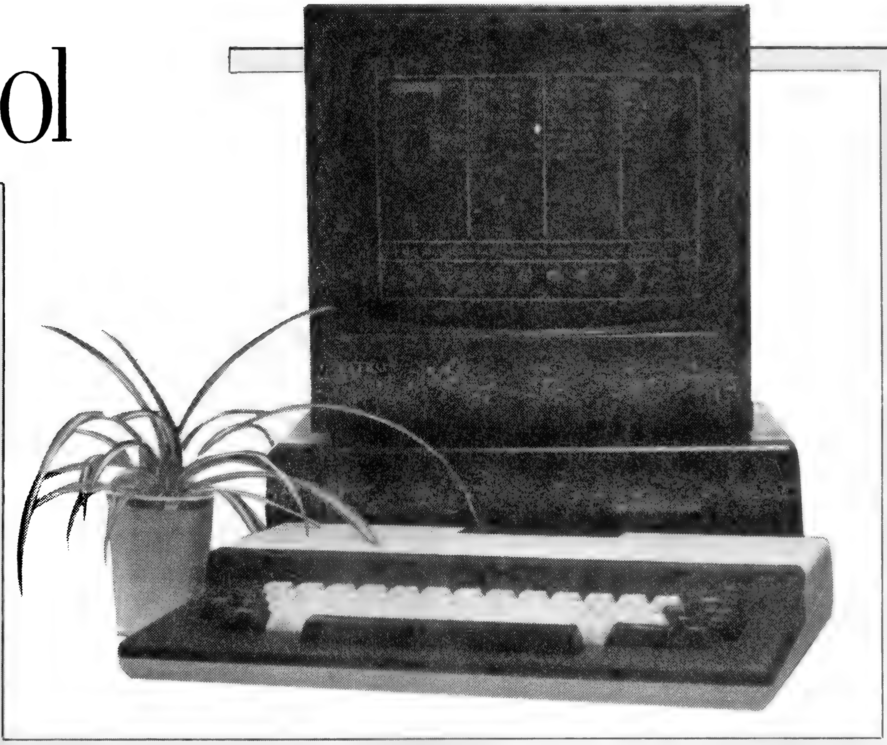
Computers and the Curriculum

Having established the desired curriculum for an appropriate planning horizon, only then is it appropriate to ask 'How can computers help in the presentation of this curriculum?'.

The school curriculum represents a diversity of subjects, some compulsory, some elective. It may well be that one of those subjects is something called 'computing', or 'computer science' or 'computer programming'. Clearly, you're not going to offer such a subject without reasonable computing resources. But computer science (or whatever else you choose to call it) is simply another subject. Too often 'computing' is the tail wagging the dog. In other words, why let the demands of a single subject dictate the computing component of all the other subjects?

Certainly the skills learned from a study of computing can spill over and benefit those other subjects. Mathematics is in a similar category. Later courses in physics or economics would be hamstrung without access to mathematical understanding. Similarly, both subjects are often enhanced by examples of computer modelling.

It is this potential impact on the 'normal' subject stream which should determine a school's policy on computing resources. Too often school administrators give way to the pressures of expediency in this regard through pressure from highly motivated, but relatively uninformed sources. The question to be resolved is 'What computing resources are desirable to effectively enhance our planned subject streams?'. To this we add the rider 'under the restraints of available financial and manpower resources'.



Three of the more popular micros for school use are the Microbee (above), the BBC (top right) and the Commodore 64 (right). A fair range of educational software packages is available for each of these machines. That for the Microbee is almost entirely locally produced, and therefore locally oriented.

Since the question devolves on its impact upon individual subjects, answers must be sought from subject administrators and their respective staffs. Not every science master or maths mistress could lay claim to a well-informed understanding of the uses of computers in their particular subject areas. Nevertheless, they have the responsibility for ferreting out the most appropriate ways of using any new forms of technology.

Software Subject

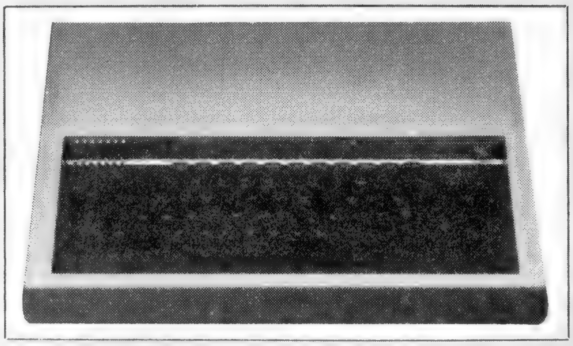
In view of the subject-oriented approach to hardware selection, the real issue is *software*. Apart from software, the hardware is just old iron. Without denigrating the Cray 1 (a $15 million supercomputer), consider the impact on your school if one were to be donated by a highly philanthropic benefactor. Could you use it? It doesn't even play Pacman! And you'd be stung with a maintenance bill big enough to pay staff salaries. In other words, all the computing power you can get is pointless, unless the appropriate software is available for it, and at a cost which can be afforded.

Put simply, subject administrators should interest themselves in software packages appropriate to their subjects. They must take the time (or delegate) to determine if potential packages are right for the subject, and right for the school. In my humble opinion, you should forget the line 'We can write our own software.' Teachers teach. Programmers write programs. Put the two together, and you wind up with a very time and money consuming exercise. Leave it to the experts and the software entrepreneurs. Even if your school comes up with a real whiz-bang program to teach conic sections, it's just one program. You're going to need many, many more.

One exception to the above rule applies when the software is a joint development supported by a number of schools with pooled resources.

Picking Programs

The analysis of available software packages is time consuming (and therefore expensive). Lean on those who have already made some assessments. Read software reviews published by reputable magazines and journals (preferably British or



A large percentage of BBC programs come from the UK, and these have been generally accepted as being compatible with Australian teaching and learning objectives.

The Commodore has drawn software development from a number of countries, some of which is applicable here.

Australian). Talk to schools who feel they have made the transition with a degree of success.

Another good source is the monthly *SIGCUE* publication (from the US-based ACM). This is the Special Interest Group for Computer Users in Education. Similar publications originate from the UK.

Once the school develops a sample profile of desirable packages (there's no need to wrap up the whole list of requirements), begin to look at what hardware is required for their support. Many packages are available in a variety of formats to run on different machines.

Here's a very simple way of analysing your findings: Prepare a table with one line per package, and columns for 'Package Name', 'Value', and a column for each micro you are prepared to consider. The heading 'Value' is the percentage value of having the package (not the dollar value). For example, if the package is nice but you could live without it, give it 40 per cent. Give 100 per cent to packages which you really need. The table below is a fictitious example. Note how the value has been set in each hardware column where the package is known to run on that hardware.

Package Name	Value	IBM-PC	BBC	M'Bee	Apple	Com 64
Fast Physics	80	80		100	80	
Whammo Pascal	100	100	100	75		
Maths III	75		75			
French Drill	60				60	60
DescripGeom	100		100	80		
WritersPad	80	80	80	60		
History Quiz	60				60	60
		260	355	315	200	120

After summing the hardware columns, one comes up with a better picture of what could be the preferred hardware. However, life wasn't meant to be that easy. If, for example, the history department absolutely, definitely and without argument wanted a unique Aussie-written history teaching package, and if that ran only on the Microbee, then even though it scored lower in the assessment, it may still be preferred over the numerical winner (in this case, the BBC).

Other factors also come into this assessment. The numerical analysis above fails to take into account the total cost of providing computing facilities. It may well be that brand X scores higher than brand Y, but brand Y can provide double the number of keyboards for the same total outlay. One approach would be to rank the hardware in descending order of total value, and then to assess the feasibility of each contender starting from the top of the list.

Factors to be considered in this 'second pass' would include the availability of networking systems, the possibility of sharing developments with other schools, the assurance of an on-going commitment to the product line by the Australian representatives, and so on.

Taking a Feather

In assessing software packages for use in high schools, a major consideration is that Australian schools generally model their curricula on British rather than American standards. In spite of Apple's earlier lead in educational computing in this country, there seems to be a growing body of opinion that software of Australian or British origin has now reached a viable level, and certainly competes strongly with offerings from the USA.

This was born out by discussions with a number of high school principals, teachers involved in computing, and educational computing centres. What is apparent is a growing interest in the Australian-produced Microbee, the British BBC microcomputer, and the Commodore 64. There is a slow, but developing interest in 16-bit systems, where the major concern is for interactive graphics (for example, in CAD/CAM applications). Apple, it is rumoured, has hired a research organisation to find out why its sales are below expectation. Perhaps apple pie is just too all-American for Aussie schools.

The need for true Brit-ware was expressed by Roger McShane of Tasmania's Elizabeth Computing ▷

Centre. Although much of the ECC's service is provided through TASNET (a minicomputer-based timesharing system) it has provided approximately 1000 microcomputer systems for Taswegian schools. Only a handful of these are Apples, the remainder being BBC Microcomputers. The ECC is also actively involved in the development of specifically Australian software educational packages for the BBC Micro.

It needs to be understood that there was no question of 'Wow! Isn't the BBC a great little machine!'. The issue was simply that software was available to meet the criteria of the ECC's educational objectives. As simple as that. Tasmanian teachers are using the BBC in computer literacy courses, mainline non-technical subjects and science. The machine also serves to run typical business packages such as spreadsheets and word processors. They were also impressed with the broad backing of the product and its associated educational support program for both students and teachers.

South Australia's Angle Park Computing Centre is another state-oriented approach to computer education. Although its staff anticipates a move toward 16-bit systems during the next three years, there is presently a strong bias toward the BBC Micro for the reasons given above. Indeed, Angle Park has recommended the BBC to schools as the preferred system. High schools typically require a much broader range of software than primary schools, hence the criteria are somewhat different. For example, the Year 11 computing course has one-third of its subject matter devoted to programming, the remainder being concerned with typical applications including spreadsheets and word processing. The preferred language is Pascal, although other languages are introduced for comparison.

Apart from the BBC micro, Angle Park has a number of Macintoshes as part of a special development project. A small number of Microbees provide the CP/M environment for studies in the Prolog language system.

The point being made here is that these two independent approaches have been guided by the software needs of particular curricula, not by hardware expediency.

By the same token, the availability of certain computing resources has an impact on the curriculum. If certain teachers know they can develop mathematical models for physical processes such that students learn by interacting with graphics, they are more likely to include such modelling in the course. Some such 'experiments' can only be modelled. One example is the simulation of travelling at near light speeds, illustrating the effects of relativistic shortening, time dilation and mass increase. I know of at least one simulation which shows how the view from the front of the 'space ship' would distort as its velocity approaches the velocity of light.

Another example relates to economic modelling, where students develop a mathematical model to predict the effects of an increased advertising budget and altered selling prices on potential sales of a product.

In many cases, a single microcomputer in the classroom would meet such special needs. It would be necessary to have some means to enable all members of the class to see the screen at the same time. A large screen projector would be adequate, provided the micro (or its terminal) was equipped with a standard video output.

Queensland's St Peters Lutheran College is also majoring on the BBC Micro. This school covers Years 1 through 12 and has had ten years of experience in educational computing, starting with a time-shared PDP-11/34. There are nine BBC micros for class use, and a number of staff have their own personal BBCs which they use for course development. The primary interest in the high school is not so much programming, but applications. Packages available for study include spreadsheets, simulations, word processors and a database. The BBC also operates as an electronic blackboard. The Computer Studies course includes a variety of programming languages such as BASIC, Pascal and Fortran.

In regard to programming languages, an interesting comment was made by Professor Shir Nijssen when addressing a recent education conference. His concern was that educators should abandon regular procedural programming languages in favour of fourth- and fifth-generation systems. His favourite (since he had a hand in its development) is SQL; but it needs an IBM-PC with hoots of RAM. I'm sceptical. Third-generation languages (to me, at least) are the logical link between the human intellect and problem solving. But then, I'm a die-hard.

Computing at New South Wales' Trinity Grammar began several years ago with four Apple computers donated by the school's Parents and Friends Association. These provided the foundation for the school's next move, in 1983, when it installed a network of BBC microcomputers in both the Senior and Preparatory schools. The school's decision was directed by the availability of software and networking capabilities.

Breaking with the BBC Micro tradition are a number of NSW high schools, where the Microbee has a strong body of support. I talked with David Coote, the headmaster of the Blue Mountains Grammar School. A confirmed computer-literate, he has his own MSDOS system (a Dulmont Magnum) and is planning long-range enhancements to the school's existing collection of Microbees. The school has a small but active Computer Education Committee, which is studying the potential of networking, among other things. The development of software for the Microbee is being considered as a possible joint project. The availability of specifically Australian software for the Microbee played a major role in that machine's selection. Applied Technology (which manufactures the Bee) has a strong programme of product development, including such goodies as built-in networking facilities and a user-friendly CP/M interface.

Three Computer Applications

We can identify three types of computer application in schools:

- administrative uses
- teaching and learning
- learning about computers.

Most of the educators I spoke with felt the administrative uses were so different from the other two areas, that hardware selection here was in an entirely different ball park. Here, it was generally felt that what was needed was either a plain vanilla CP/M-80 system with a decent printer and a reasonable amount of disk space, or a new-fangled (but still plain vanilla) IBM-PC (or work-alike). They felt the disk space available on the regular PC was insufficient, and were more inclined to consider the XT model with 10 Mbytes of hard disk.

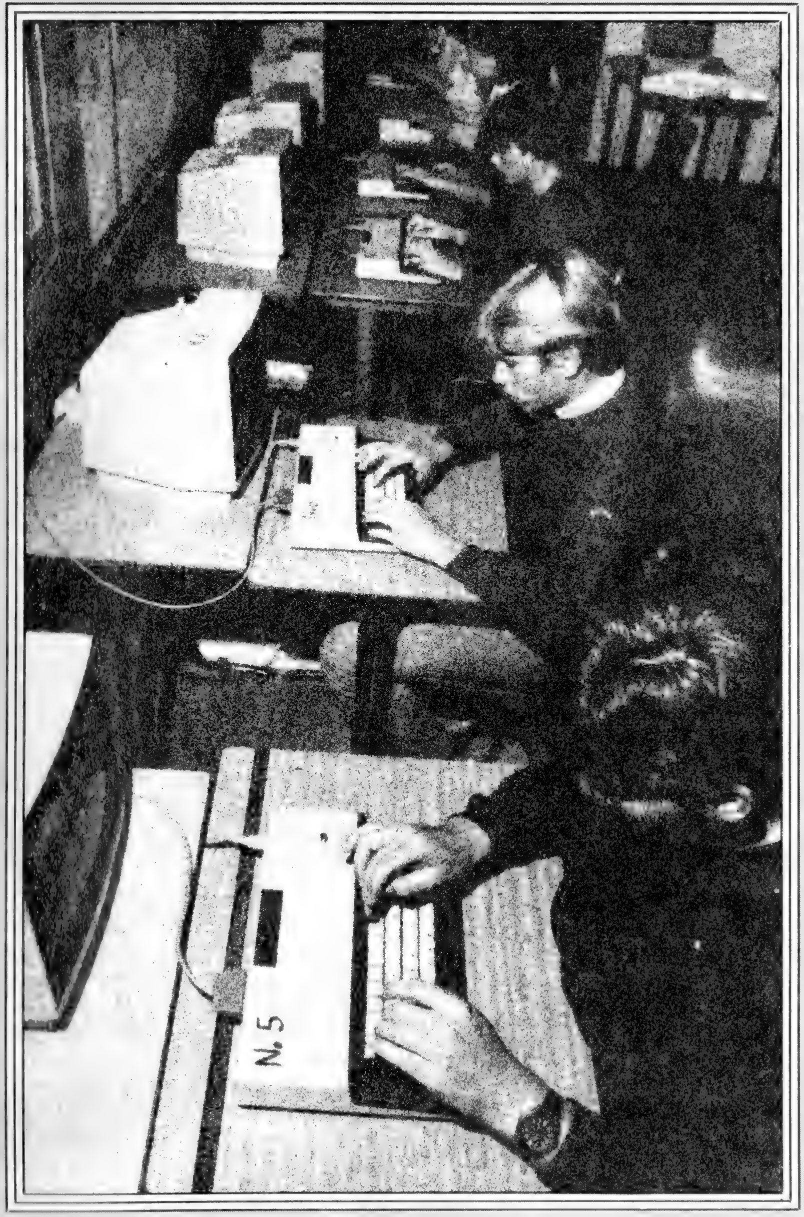
By contrast, Trinity Grammar found its Apples were excellent in assisting staff in their course administration. In particular, the Senior Master pioneered significant database applications for the school's academic administration. This in turn led to the adoption of more efficient administrative methods and facilitated the flow of administrative information. The school also uses a Wang for financial administration, and it is expected that this machine will eventually take over some of the Apple applications.

Schools are also aware of the general significance of the third category above – 'learning about computers'. There are courses in 'computer awareness' and 'computer literacy'. These are most often seen as compulsory courses for all students, and concentrate on the role of the computer as a problem solving tool.

So there you have a little food for thought. Don't be too persuaded by the prevalence of BBC Micro users. While current practice can be an important guide, things stay still for only microseconds in this most rapidly developing field of high technology. Nevertheless, a strong body of informed opinion is difficult to ignore.

By the by – did you notice that nowhere in this article have we indicated the CPU (central processing unit) type of any of these machines? Does it matter? Do you care if it's eight or 16 bits? You might as well worry about its colour scheme – it's just as important.

Finally, an encouraging note (but don't hold your breath). Emerging from a plethora of differing state approaches to the use of computers in education is the National Task Force on Education and Technology (NTFET). This eleven-member committee is charged with (among other matters) the development of options for consideration by the Australian Education Council. In particular, these options include policy and program initiatives to assist and stimulate pupils at all stages of education, in response to technological change. Perhaps, in the long run, we may well see a coordinated approach, which can only benefit our students by arranging all the rowers in roughly the same direction. ■



"Third-generation languages are the logical link between the human intellect and problem solving."

Choosing a

Although both primary schools and high schools are faced with a similar choice in terms of computer hardware, the software requirements for a primary school differ markedly from the more sophisticated needs of secondary education. There is greater emphasis on fundamental numeric and word skills, as well as subjects of greater generality. Keyboard skills are perhaps best developed at the primary level, along with a degree of 'computer literacy'. There is less concern with programming.

It is more difficult to justify the acquisition of floppy disk drives (versus cassette) and networking systems in a primary school, although some primary schools have made excellent use of these facilities. The floppy drives facilitate the saving of 'work in progress' for students writing programs or essays, but such activities have less emphasis in the primary school. While it takes considerably longer to load a program from cassette, once an application is n the computer it should remain aded for some time in order to rvice a number of pupils. lternatively, 'broadcast' downloading ee the article 'Networking in chools') of programs may offer savings in time and money, as well as improving the reliability of the loading operation.

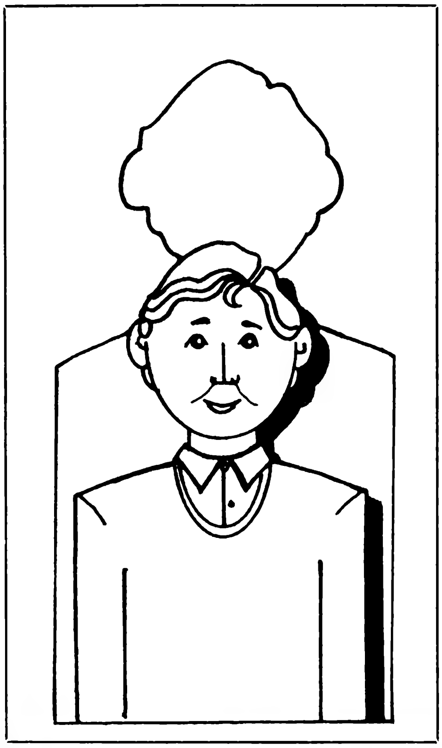
As a guide, the latest (August 1984) software catalogue from Barson Computers (for the BBC Micro) covers some 20 major educational categories ranging from art and biology to teaching aids and word processing. Categories of particular interest to primary school teachers would include art, computer learning, educational games, general science, geography and social science, home economics, language arts, mathematics, music and teaching aids.

At a rough guess, about 25 per cent of the total offerings in the Barson catalogue would be appropriate to the primary school level. That's a lot of programs.

The traditional Apple II has a similar range of educational software, although much of it has a distinctly

computer for a Primary School

The general guidelines given in the previous article apply equally well to the selection of a computer for a primary school. The fundamental guiding principle is still software availability. Here Frank Lee writes briefly on how choosing a computer for primary education differs from choosing a machine for secondary students.



American flavour. While this is especially noticeable in the programs designed for secondary use, it seems to be less of an objection at the primary level.

Since the effectiveness of microcomputers in the classroom depends heavily on available teacher expertise, avoid the trap of buying a variety of machines. If a school has Apples, BBCs and Microbees, it will need teachers who can supply the technical know-how for all three. Generally, this will dilute the available expertise, although some teachers are specially gifted at adapting to new systems.

Another reason for sticking with one brand is that it lowers your total software outlay.

Do primary schools need computers? You bet they do. The computer is an information machine of extraordinary versatility and generality of application. To ignore such a tool is to be ignorant of the role of education in society.

Go forth and buy! ■

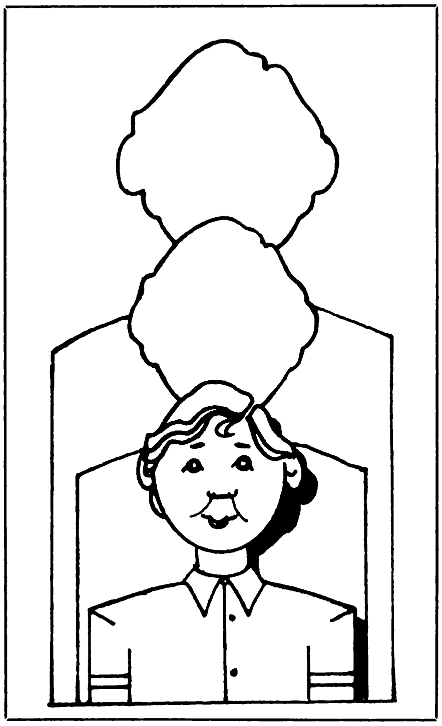
Computing in an Infants School

While many parents and teachers might hesitate to introduce children to the abstract world of computing at an early age, several infants schools have used computers with great success. Vaucluse Public School is among them. Here Barbara Thomson, infants mistress at Vaucluse, describes how she went about introducing computers to children from Kindergarten to Year 2.

Vaucluse Infants School Club bought the department an Apple II in November 1982. This was part of Apple's 'Kids can't wait' programme and included the Logo package. Having read the August '82 edition of *Byte* magazine and Seymour Papert's *Mindstorms*, I was both intrigued and excited at the prospect of being able to find out if Logo had the enormous potential for young children that was being claimed.

(Logo was developed in the late Sixties by Seymour Papert. The essential idea was that Logo should be suitable for children and other computer novices, yet provide a language for continued learning and problem solving. In Logo Papert has developed the philosophy that children can increase their own intellectual structure without being formally taught. The language allows them to explore, create, plan and program.)

The software available in 1982 was not at all exciting, and seemed mainly devoted to mediocre drill and practice exercises. The idea of spending a considerable amount of hard-earned school funds to do the same old things in thinly disguised versions of the same old way certainly was not justified, but Logo fitted the school policy of providing for individual differences and helping children develop thinking skills. During the Christmas vacation I attended courses at the Computer Shop in Logo and administrative applications (learning about databases and word processing).



1983 – School Organisation

When school resumed in 1983 I quickly realised that although the staff were interested in using computers, it would take a long time to get the programme off the ground.

We have a staff of seven in the infants' department and an enrolment of 206. Teachers are keen to organise their classes and every infant teacher realises that the school day is overful already without introducing yet another subject area to master.

Problems such as where the computer should be housed, setting up each morning, in-servicing of staff and security also had to be considered.

All children were to have access to the computer. The idea that it could be used as a reward, or that computer time would be refused for misbehaviour, was rejected from the outset. We were also alert to the problems women were facing in regard to computer technology and saw introducing computers to very young children as an opportunity to ensure that they would be used equally, regardless of sex.

Parent and Teacher Education

Courses for teachers and parents were held in the first three weeks of term in 1983. These courses began with using the introductory program 'Apple Presents Apple', which provides an excellent start to understanding the computer. I then went on to Logo lessons - with some trepidation, as I was sure some people would question the meaning and implications of it. This fear proved to be uncalled for, since everyone became enthusiastic about

> "... large posters showing computers and their uses in society had been hung on the walls, and charts displaying rules for using the computer were in an obvious spot."

introducing Logo to the children.

Once the parents and teachers felt confident that they could begin working with the children, a roster was set up under which parents would accompany groups of four children to the computer room (the infants office).

Here large posters showing computers and their uses in society had been hung on the walls, and charts displaying rules for using the computer were in an obvious spot. Logo commands which parents and teachers would need to know when supervising children, and procedures for loading disks, were also visible. Work cards for various levels of ability had been made.

To broaden the children's understanding of the 'turtle' and how and why it does what it does, activity cards had been made so teachers could 'walk' the children through the steps they would later program the turtle to make (see Figure 1).

Child Development

The children were immediately excited and enthusiastic about this new addition to their school activities. This was to be expected, since we all know children respond to new developments far more positively than adults - they have a wonderful zest for learning and are much less concerned about failure.

The talented children quickly understood how to make the turtle do their bidding, and developed skills which enabled them to advance to higher levels of usage. Teachers generally try to cater for individual differences, and the bright child poses a challenge to us all. I found the computer a wonderful aid in

ROBOT CARD 12

You will need:
The START and FINISH cards.
A trundle wheel.
A partner to command you.
A clipboard and pencil.

READY?

1. Place the START card beside the hibiscus tree, with yourself facing the primary building.
2. "Forward 8 metres".
3. "Right 90 degrees".
4. "Forward 6 metres".
5. "Left 90 degrees".
6. "Forward 2 metres".
7. Put down the FINISH card.
8. Your commander now should have drawn your movements.
9. Now you be the commander and your partner be the robot.
10. I'd love to see your clipboard drawings.

Figure 1. An activity card for children using Logo.

▷

Infants School

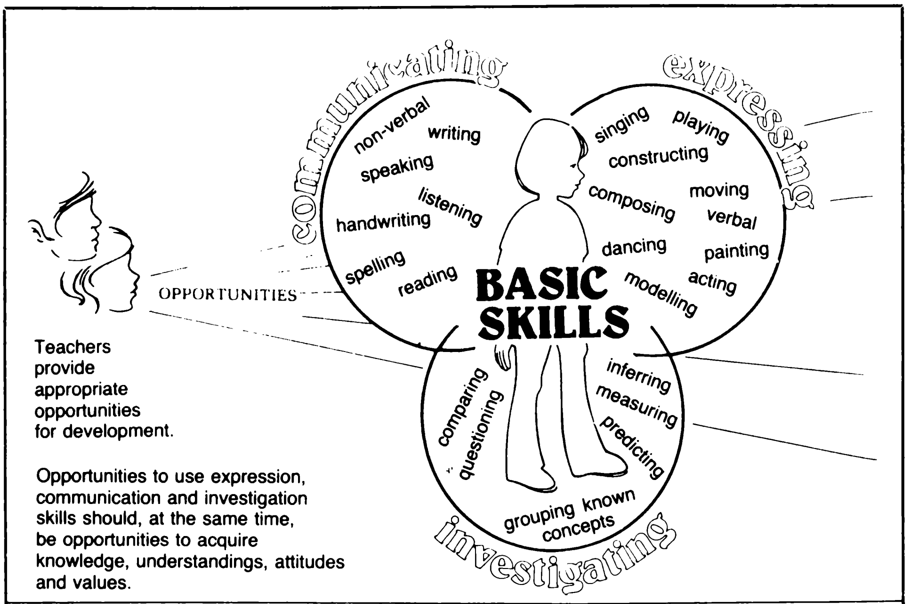


Figure 2. A representation of the skills teachers should be fostering in their students.

encouraging their inquiring minds.

Children at a remedial level were motivated to try just that little bit harder. They found the computer had a never-ending supply of patience and was absolutely consistent. Several of these children developed skills in Logo far in advance of many others, which enhanced their self esteem. They became leaders in our computer club and helped in setting up the machine each morning.

The adults involved in our programme quickly realised the resource we had in our more mature children. They were encouraged to assume the role of teacher for younger children, which was a bonus for both the learner and instructor.

All children developed thinking skills. They began to make notes, planning the designs they would try out when it was their turn on the computer which they had named 'Oogl' (an anagram of Logo). They developed in their ability to explain their actions, and also showed a positive attitude to making mistakes. There seemed to be a carrying over of the effects of the Logo exercises to other aspects of learning: the children exhibited greater self-esteem, confidence, discussion skills and self-discipline.

Fostering skills of investigation, expression and communication is what education is all about. Wise use of computers can help us achieve our aims (see Figure 2).

Activities which develop the investigative skills of comparing, measuring, approximating, predicting, inferring, hypothesising, calculating, exploring, discussing, and co-operating are time-consuming and difficult to generate in the classroom. Logo is an excellent means of fostering these skills and provides an environment in which the child is in control, investigating and generating activities which are meaningful to him or her.

With only one computer at the school, it was important that Logo activities be carefully planned so we didn't waste the limited access time. It was also necessary to organise a fair roster for using the computer in free time.

Staff/Parent Development

Staff interest grew throughout 1983 because of the skills they could see developing in the children. Teachers realised that they not only needed knowledge of Logo, but had to re-evaluate their teaching strategies to fit in with a Logo environment.

Classroom teaching styles sometimes need to be revised. The optimum use of the computer means that learning becomes much more individual and teachers need to be aware of children's levels. So often we teachers itch to interrupt children with "It would be easier if ...", or "That won't work", instead of allowing them to discover and learn from their own mistakes. Papert has given us a wonderful tool with which exciting child-centred learning can take place.

The parents who were involved in supervising the Logo groups became convinced that the children were learning valuable skills. These parents were also Infants Club members, and their fund-raising efforts allowed us to painlessly acquire a printer and order a second computer.

An interesting outcome of the parents' work with Logo was that some found they had improved their own concept of position in space and could, for example, read a street directory without turning it upside-down.

In Leaps and Bounds

With staff and parents continuing to show interest, and with an extra computer, all children from Kindergarten to Year 2 could have more access.

A drill and practice disk was bought for kindergarten classes, to make the introduction to computers both positive and motivating. Little time was needed for them to become confident in its use. Keyboard skills developed quickly and these youngest school children were soon keen to produce patterns similar to the ones they could see on display around the computer. Kinderlogo, a simplified version of Logo was introduced, and sound progress has been made.

Word Processing and Process Writing

In 1984 we bought Bank Street Writer, a word processing package for children. I had been using Sandy's word processor for administration work - such as letters to parents, class lists, pupil information, programming and staff development - and it soon became apparent that in watching me use the word processor the children were developing skills themselves. They eagerly took over updating class lists, and thought of other uses for word processing. Their poetry collections were enlarged and, since singing is very popular, new songs were added to our song books. The ease of correcting errors using a word processor was a delight to them.

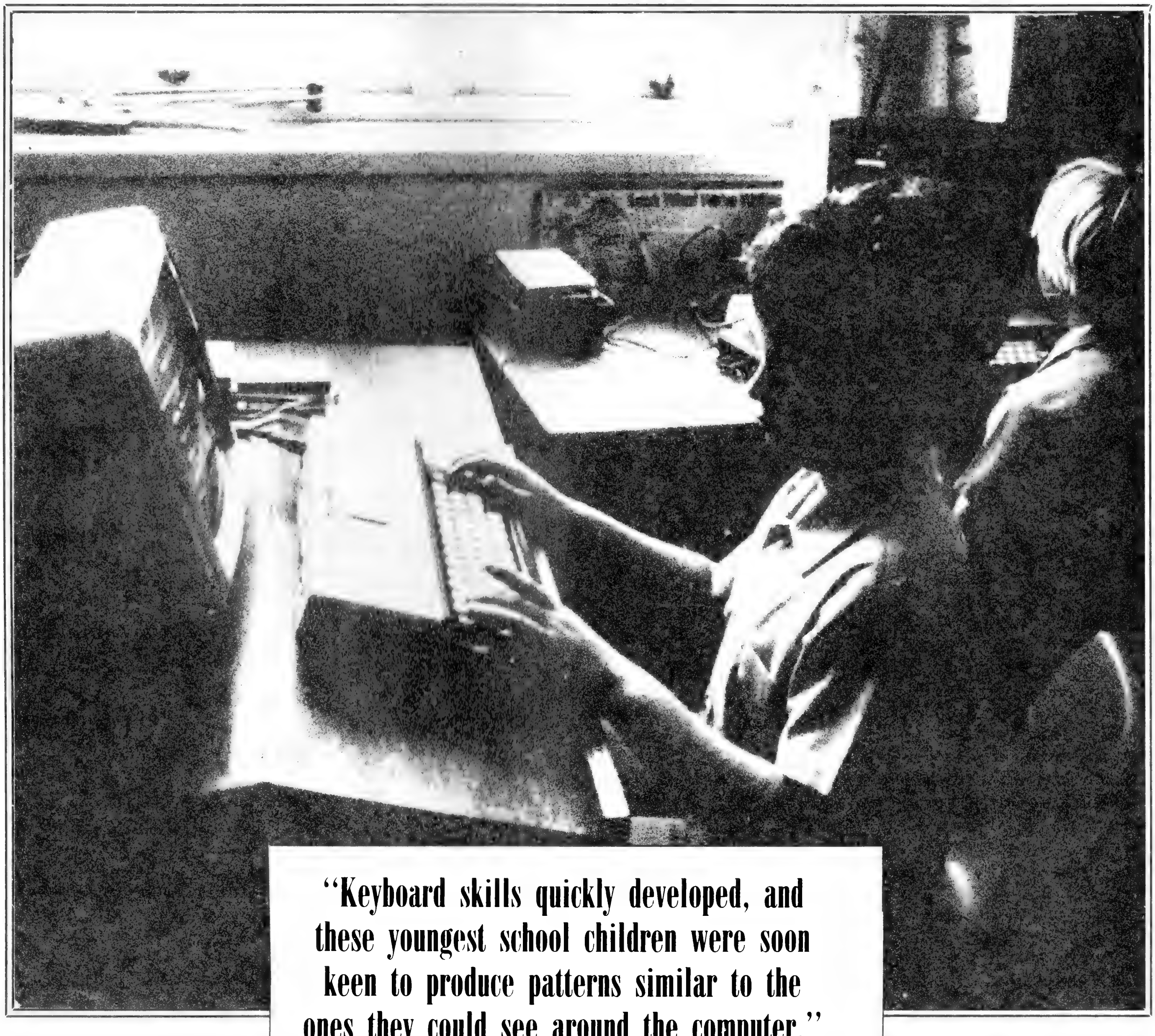
New ideas for using Bank Street Writer are constantly surfacing, both from children and staff. The only constraints on our activities are computer access time, and typing speed and skill.

Process Writing using Bank Street Writer has a high priority for Years 1 and 2. To save valuable time, a parent has offered her services for typing first story drafts in quickly. She can key in 30 stories in no time, so the children can then review, discuss and think about changes they would like to make. There is no doubt that the quality of the children's writing has improved, but more importantly, we've observed a marked change in attitude to correcting mistakes, inserting passages and rearranging sentences.

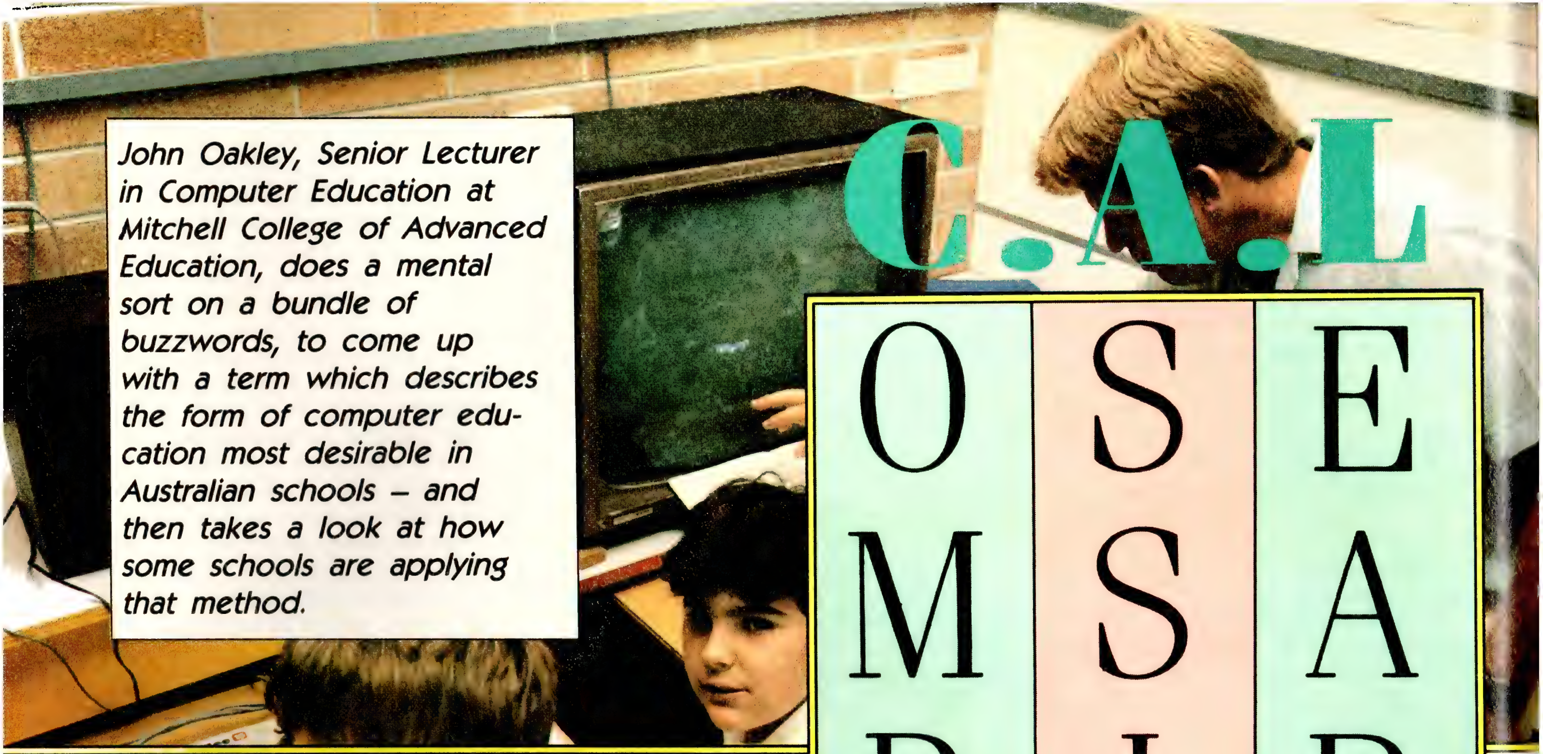
It's Been a Success

I feel confident that computers will play an increasingly important role in our children's lives. I justify their introduction to an infants school with the fact that enormous strides in learning can be made with very young children. Although research carried out on the effects of Logo is sketchy, it would appear that benefits can be gained for all children, from the handicapped to the intellectually superior.

Of course, the computer's use in any classroom must still be accompanied by all the meaningful activities in which children are using concrete material to investigate their world. The computer will not miraculously turn all children into logical thinkers, and it will not solve the many pressing problems confronting educators today. However, it is a powerful teaching and learning tool, and it is up to us to make wise use of it. ■



"Keyboard skills quickly developed, and these youngest school children were soon keen to produce patterns similar to the ones they could see around the computer."



C.A.L

OMPUTER SSISTED EARNING

John Oakley, Senior Lecturer in Computer Education at Mitchell College of Advanced Education, does a mental sort on a bundle of buzzwords, to come up with a term which describes the form of computer education most desirable in Australian schools – and then takes a look at how some schools are applying that method.

What is computer-assisted learning? Is it the same as 'computer-assisted instruction' or 'computer-based learning' or 'computer-managed instruction'?

Confronted with the jargon this is a reasonable question for any parent or teacher to ask. The terms and their usage certainly have the potential to produce uncertainty and confusion, even among computer-using teachers themselves. The answer for me is unequivocable. In the United States the term 'CAI' or 'computer-assisted instruction' is the most used. This term has connotations of direct instruction, which many educators in Australia and the United Kingdom would find unacceptable, although they recognise and accept that direct instruction does have a place in education. However, to suggest in the Australian context that computers ought to be used principally for direct instruction is sure to bring howls of protest from thinking teachers and parents alike.

Australian educators see the computer as a sophisticated teaching/learning aid which assists in the learning process. Strong emphasis is placed on the pupil-centred process of learning, rather than teacher or computer-directed instruction in which the pupil has little or no control over the learning situation. Consequently, the term 'computer-assisted learning' has much greater acceptance in this country's schools than does the term 'computer-assisted instruction'.

The terms 'computer-based learning' and 'computer-managed instruction' are not commonly used in Australian schools, as they imply that the computer is the dominant learning mode, or that the computer is used to present and control a significantly long teaching/learning experience. To date, these modes of computer use have tended to be confined to the United States, and specifically to tertiary institutions and the armed forces. Given the philosophical stance of Australian teachers, it is unlikely that either of these modes of educational computer

in Practice

use will be adopted by a significant number of Australian schools, even if the courseware were to become available.

Separating Rhetoric from Reality

Having established 'computer-assisted learning' as the most desirable and commonly used term relating to the use of computers in schools, in what ways then is the computer actually used in Australian schools? What is rhetoric and what is reality?

You only have to read educational publications such as *Classroom Computing, Arts and Education, Computing in Education*, or *Information Transfer* to be presented with a wide range of alternative uses for computers in classrooms. Does this list of possible uses have currency in our classrooms? Unfortunately, the possibilities, the promises, and the rhetoric, are reflected in a very small proportion of Australian schools, and then only in part.

The reality is that limitations in terms of teacher knowledge of the possible uses of the computer, hardware costs, and availability and cost of suitable software, are such as to result in a very uneven usage of computers in classrooms.

To illustrate this point, a summary of responses from teachers, male and female, selected from infants, primary and secondary classes, state and non-state schools, in each of the ten educational regions in New South Wales is presented in Figure 1.

A Survey

This summary is significant because it represents a fairly random sample of schools which have at least one teacher sufficiently interested in the educational use of computers to apply for a Computer Awareness Course for Classroom Teachers (held at the NSW Department of Education Retraining Unit in Leichhardt, Sydney). It is also significant in that it does not include schools having no interested teachers, or schools identified as playing a leading role in educational computing.

The summary shows dramatically the wide variation in computer resources among the schools in this sample. For example, Primary School 2 has a ratio of one computer to 14 pupils, while Primary School 4 has one computer to 300 pupils, and Secondary School 9 has a ratio of one to 720. It would seem the number of computers in a school is more directly related to the attitude of the principal and staff towards computers in the classroom than to its financial resources, since schools in similar socio-economic circumstances vary greatly in their computer resources.

In educational use of computers there is a clear differentiation between secondary and primary schools, in that secondary schools tend to use computers principally for administration and the 'specialist subjects' of computer awareness and computing studies, whereas primary schools use computers across the curriculum.

This is almost certainly directly related to factors such as the way schools are structured; the misplaced belief in secondary schools that computers are the province of mathematics teachers and have little to offer other subject specialities; and that, like all other subjects, computer-related activities ought also to be put into 'boxes'.

Primary schools do not suffer the organisational constraints imposed by subject specialities, since every teacher must have competence in all subjects. Furthermore, the nature of primary teaching encourages a broad curriculum approach to computer usage.

However, this survey, while indicating significant differences between usage in primary and secondary schools, also reveals that many schools are not realising the full educational potential offered by computers. They are frequently confining computer usage to the educationally less significant and, in computing terms, less powerful capabilities of the computer.

Fortunately, the computer's potential *is* being realised in a small number of widely scattered schools, and it is these uses that set the computer aside as the most powerful teaching aid yet devised. It is the power of the computer, and its profound impact on society, that needs to be realised by pupils and teachers alike. Knowledge of this impact is critical in today's society and consequently, most secondary schools and many primary schools are currently, or will in the very near future, be teaching computer awareness to their pupils. The summary indicates that secondary schools implement computer awareness as specified courses. Primary schools, on the other hand, tend to rely on 'hands on' experience to achieve this aim.

How Brands Affect Usage

Apart from the intrinsic differences between primary and secondary schools, which account for their different uses of computers in the classroom, there are other significant differences between schools, which appear to be a function of the type of computer used and the software available for that computer.

It is not an accident that primary schools which tend to purchase a certain brand of small, cheap, less-powerful computer, usually without a disk drive, concentrate on rather trivial drill-and-practice activities, a version of Logo restricted to 'Turtle Graphics', keyboard skills using a typing tutor, and word processing. While it could validly be argued that some educational computing experiences are better than none, it is nevertheless disappointing that more schools cannot afford the more expensive, more powerful computers which have a much broader base of educational and general software, and hence are able to provide types of learning experiences which cannot easily be provided by other means.

Given this overview of how schools are using computers, a more detailed analysis, including schools that are very actively using computers, appears below.

A More Detailed Analysis

Secondary schools tend to use computers in three major ways: in administration, teaching computer awareness, and teaching computing studies.

In some states syllabuses have been developed by the state Department of Education. In other states, such as New South Wales, no such centrally developed syllabuses or curricula have yet been released, so many schools have exercised their own initiatives in these areas.

Relatively few secondary schools have expanded the use of computers ▷

into general subject areas such as English, science, or social science. In contrast with most primary schools, secondary schools tend to set aside a special room to house the computers which are increasingly being 'networked'; that is, linked to a master computer which exercises overall control. There are cost and security advantages associated with this approach. Many schools nevertheless combine the network approach with individual computers located in strategic academic areas, thus giving maximum flexibility in their use.

In primary schools, the initially acquired computer has frequently had its home in a particular teacher's classroom, or has been shared among several classes on a rotating basis – usually in a classroom for a part of every week or, for example, one week in four.

However, primary and infants teachers have almost unanimously expressed the view that their use of the computer is most effective when it becomes part of the furniture within each classroom. This provides strong motivation for a school to purchase sufficient computers to be given to all classes.

Reports on how primary schools set about using computers in their classrooms indicate strong emphasis on the early acquisition of keyboard skills, through the use of typing tutors. In fact, some schools insist on pupils spending a lengthy period mastering keyboard skills before being permitted to progress to other uses of the computer. Some competence with the keyboard is obviously advantageous if a child is to carry out word processing. However, experience has shown the lack of keyboard expertise does not place insuperable barriers to many of the

Primary Schools	No of Pupils	No of Computers	Drill and Practice				Social Science	Logo	Typing	Word Processing	Games	Sec. Maths	Sec Special Ed.	Computer Awareness	Computing Studies	Administration	Reasons for low Usage
			Maths	Reading	Spelling	Language											
1	600+	2	●	●	●	●		●	●	●	●	●	●	●	●	●	
2	300	22	●		●	●					●						
3		2								●					●		
4	600	2															No teacher expertise
5	400	7	●					●	●								
6	83	2*	●							●							
7	158	2	●	●		●	●										
8	200	5	●			●			●	●							
9	275	5	●	●	●				●	●							
Secondary Schools									●								
1	500	8													●		Limited Microbee software
2	800	11													●	●	No software for Ataris
3	500	6											●	●		●	
4		2										●	●		●		
5		6													●		
6		6															General staff opposition
7		13										●			●	●	
8	50	2*										●					
9	720	1															Stored in Maths storeroom
10	800	2										●	●	●	●		

Figure 1. The results of a survey of teachers attending a 'Computer Awareness Course for Classroom Teachers' at the Department of Education Retraining Unit (New South Wales, August 1984), showing the application of computers in the curriculum of 19 schools.

*** Indicates computers owned by the teachers themselves.**

computer experiences available.

In relation to word processing, which is most frequently used in conjunction with the 'process' approach to creative writing, many schools are overcoming the problems of lack of keyboard skills and limited access time available to pupils by utilising skilled adults to work with the pupils. Whether this detracts from or enhances pupil motivation for the task of writing has yet to be determined. What is certain, however, is that the standard of creative writing is generally considered to be much higher than with traditional approaches.

With respect to the actual word processing program used, it would seem that even infants children cope adequately with sophisticated programs. In fact one Year 2 class expressed a preference for the Sandy's Word Processor (for adult use) over Bank Street Writer which was specially written for children.

Another more common use of the computer in primary schools is in the area of drill and practice of basic skill subjects. Much of the software in this area leaves a great deal to be desired, educationally speaking. However, there seems to be an intrinsic motivation associated with the use of the computer, even if it is being used with such programs. Maybe this is because the computer, for most children, is non-threatening and provides a personal challenge. For whatever the reason, educationally unsound software often succeeds where the teacher has not.

Logo, a 'language for learning' specially developed for children by Seymour Papert, has received very wide acceptance among primary and infants teachers, and is increasingly forming a major part of classroom computing activities. So important is it regarded as an educational tool, that in Victoria computers that do not support Logo are not eligible for placement on the government contract list. However, not all computers support 'extended Logo', and are thus confined to 'Turtle Graphics' which is but a subset of the Logo language.

Those schools using the extended version of Logo include list processing, particularly in the area of language, as one of their classroom uses of the computer. One of the more dominant language applications is programming the computer to write creatively. To achieve this the child must analyse with great care the product he or she wishes to achieve, in order to give the appropriate instructions to the computer. Thus, not only does creative writing become great fun, but the child gains a more intimate understanding of the language.

One further disadvantage of computers without disk drives and without a large software base is that work with databases cannot be successfully implemented. Databases, by their very nature, are difficult to create and use successfully without the power of a computer. A small proportion of teachers are now using a variety of commercial and public domain database programs which enable children to plan a database, collect data, and store, manipulate, and analyse that data with reference to hypotheses that they formulate. At the infants level, simple databases set up by pupils and relating to their families, to pets, to animals and their coverings, and so on, are becoming more common.

At the primary level more sophisticated data is being collected from a variety of sources, such as archival records on convicts, and from tombstones in old graveyards. Two very interesting database projects which involved pupils in the Bathurst district working in conjunction with staff and students at Mitchell CAE have recently been carried out. Commercial databases, such as that on the First Fleet, developed by Gemini Software and the Elizabeth Computer Centre, have proved to be very successful in primary and secondary schools.

While secondary schools have tended to make little use of databases, there are exceptions. One example worthy of mention is in the area of science where a very simple database program was used by a remedial science class to set up and categorise scientific data. The significance of this work was not in the data collected, but rather in the enthusiasm generated in the pupils, who, prior to this experience, had shown little real interest in science.

As useful simulations become available, pupils are increasingly using the computer to pose 'What if ... ?' questions, and thereby exploring a wide range of alternative solutions. These simulations vary tremendously in complexity, and are used principally in mathematics, science, and social science, at both the primary and secondary levels.

A very pleasing development in recent times has been the type of program which can best be used in a group or whole class situation. This type of program requires an input which must be decided upon by the group, in response to logical or other clues given by the program itself. Examples include 'Tray' for the BBC, or its Australian Apple equivalent 'Sherlock', which contain a hidden passage of poetry or prose that has to be 'revealed' by the class. Quite apart from the language development built into the program itself, the 'incidental' language development and social interaction generated among the children has to be seen to be believed. Other programs requiring group interaction and decision-making are now making their presence felt, and represent a new and exciting direction in the classroom use of computers.

Wrapping it Up

In conclusion, the current state of computer-assisted learning in classrooms varies widely from school to school. Generally speaking, primary schools are making much greater use of the computer in the classroom than are secondary schools which are tending to use the computer to teach computer awareness and computing studies. These last have become, for all intents and purposes, additional secondary school subjects.

While some primary schools are using the computer extensively, the majority of primary schools are making little or no significant use of computer-assisted learning. This would appear to be due to three factors: lack of hardware; lack of software; and lack of teacher knowledge and expertise.

Teacher expertise and enthusiasm for computer-assisted learning does exist in many schools, although these represent a small proportion of the total. In these schools very interesting and sometimes exciting developments are taking place, which more than justify the expenditure on hardware and software.

Overall, the early emphasis on drill and practice is giving way to educationally more acceptable uses of the computer. Increasingly, the computer is being used to provide those types of educational experiences which cannot easily be provided by other means. Teachers are becoming more sophisticated in what they are demanding in software, and more thoughtful in their use of that software.

Computer-assisted learning is still in its infancy, and is effective in a very small number of classrooms. Nevertheless, it has a future and its continued development should be encouraged by the community and supported by Government. ■

Do computers play any part in your life?

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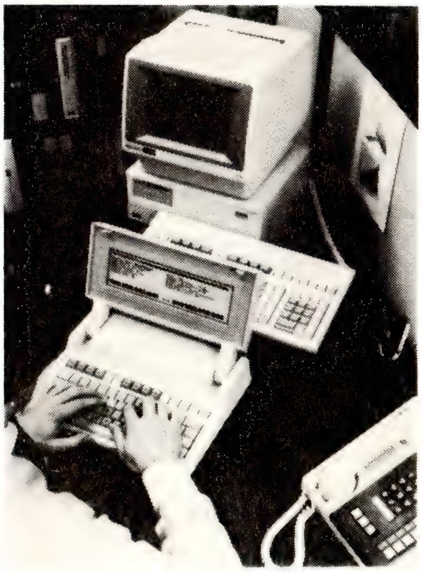

your computer

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"You don't have to make everything into a game to interest the students."

"Adventure games have a great deal to offer in the area of language development and in stimulating activity in the classroom."

"We regard multiple choice as the work of the devil, and not suitable for human beings."

Educational Software

Choosing it...Using it

The quotations on this page are a random selection of remarks about software, made by teachers and researchers who attended the Australian Computer Education Conference held in September, 1984. They are all people experienced in the use of computers in schools, an experimental area of education. It is clear, both from what they say and from the difference in their opinions, that there is as yet no defined formula for 'good' educational software – but every one of these people is using software in the classroom, in ways which they believe are beneficial to the students.

So, obviously there is 'usable' educational software around. From this one could surmise that achieving a desirable educational goal with this material depends largely on *how* you use it.

Later in this article we discuss some of the ways in which Australian teachers and teachers overseas are using software, but first there are some basic attributes which both teachers and parents who want to buy educational software for use at home should look for. These five points were outlined by David Squires from the Curriculum Project, Chelsea College, University of London, in a seminar he led at the Australian Computer Education Conference.

1. Reliability – Is the program robust? Will it run? If it runs in the shop, will it run on the configuration of machine you have at home or in the classroom? Will it continue to run – if you type in things that are inappropriate, will it cope with them? Does the documentation itemise possible problems?
2. Access – Is the program easy for first-time users to run? Is it well-documented? Is the documentation designed to enlighten you? Is the reading level right for the children who will use it? Is the way in which the program operates easy? (Beware of something that is dead easy to run initially, but is not able to address growing needs and expectations.)
3. Integrity – Is it really a piece of educational material? Are the claims associated with the software valid?
4. Relevance – Is it useful to the classroom/home setting? To the ▷

"Though a lot of people criticise drill and practice activities, children from Kindergarten to Year 4 like them."

"It seems more important what you leave out of a program than what you put in – you have to leave something for the children to do..."

"There's very little educational software around that can be described as other than garbage."

school curriculum? To the age level you are addressing? If you are a teacher, does it suit your teaching style?

5. Power – Is the software enabling you to do something different from what you'd normally be doing? Does it utilise the capabilities of the micro?

This last is one of the main criteria applied in the development of educational software at the Educational Technology Centre, University of California, Irvine. The lack of computer-based learning software available which fulfils this requirement on a grand scale is, in part, behind Alfred Bork's negative 'garbage' quote at the beginning of this article.

Bork is involved in the ETC's development of 'standalone'-type programs that teach courses for which there simply aren't enough teachers to run them at the desired level of intensity. He described one such program, an introductory course in physics for science and engineering students, in detail:

"The course follows a mastery organisation. For each unit the student has a list of learning resources and a description of what is to be learned. Students cannot continue to the next unit until they have demonstrated, through on-line quizzes taken directly at computer displays, that they know the material in a given unit perfectly. Four hundred students in the computer course take about 15,000 quizzes in the ten-week period, with feedback. All the record keeping and much detailed aid to the student, aid which is highly relevant to an error that the student has just made, is available. Students agree almost unanimously that the quizzes are learning material. Testing becomes a learning mode. In a sense, the tests *are* the course, in that they are the major learning facility for almost all the students. This way of organising courses is possible only with the computer; it has considerable promise."

Such software is known as an expert system. Designed to respond intelligently to a vast range of input on a particular subject, and to be able to 'assess' student progress, it can take years to develop and refine, chews up hours of programming and subject expertise, and hence requires a huge budget – which probably explains why so few expert systems are in use.

Australian Experts

However, at the Australian Capital Territory Schools' Authority Mathematics Centre, teachers are working on an expert system which would allow their expertise to be more widely used. The centre provides a problem-solving environment for children in Years 4-12 from schools throughout the ACT, and one of the major difficulties preventing the centre being extended to other locations is the expertise required by the classroom teacher in charge of the Maths Centre. The teacher apparently needs a high level of specialist knowledge about the tasks and the student responses to them, which a normal teacher has not been trained to have. An expert system, however, could be developed to incorporate such knowledge and thus handle conflicts, justify results, and provide a high level of motivation and satisfaction to the student. Figure 1 shows the components of an expert system.

In a paper written for the Australian Computer Education Conference, K. Fielden, J. Catton and V. Gledhill, all involved with the Maths Centre, wrote, "The expert system will be

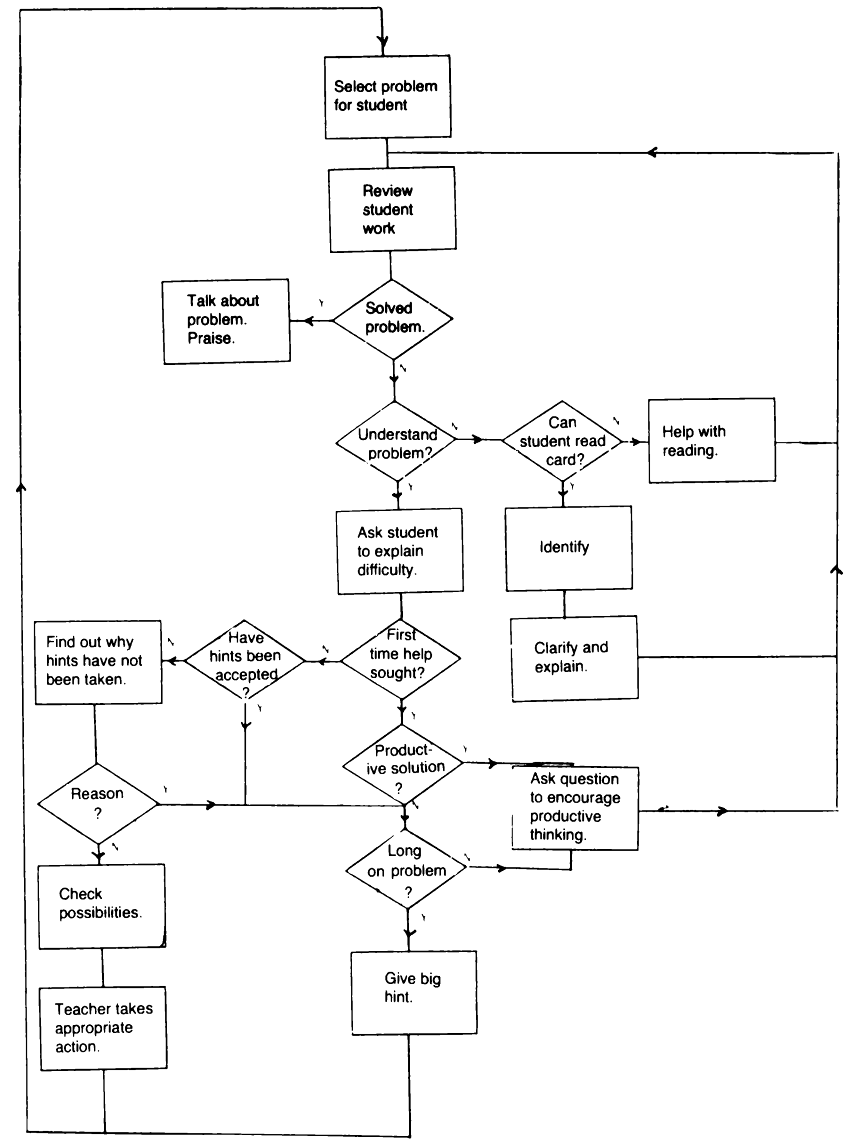

Select problem for student
Review student work
Talk about problem. Praise.
Solved problem.
Understand problem?
Can student read card?
Help with reading.
Ask student to explain difficulty.
Identify
Find out why hints have not been taken.
Have hints been accepted ?
First time help sought?
Clarify and explain.
Reason ?
Productive solution ?
Ask question to encourage productive thinking.
Long on problem ?
Check possibilities.
Give big hint.
Teacher takes appropriate action.

Figure 1. The components of an expert system.

applied to two tasks in the Maths Centre. First, it will be used to select problems at an appropriate level for the students attending the Maths Centre. The expert system will be given an order to select a group of problems. As a result of the student's attempt to solve a problem, the system will modify its selection to match the needs of the student.

"Second, the expert system will provide guidance to students who require advice. This will require a set of rules that relate to general problem-solving skills such as correct understanding, and a further set of rules that relate to the specific task being undertaken by the student."

Simpler Systems

But software needn't be this complex to be effective in schools. In fact, Rosemary Fraser, from the Shell Centre for Mathematical Education at the University of Nottingham, England, has been involved in research which shows that, for software which is to be used in a normal primary school classroom situation, what you leave out of the program is more important than what you put in. At ACEC she said, "It's very tempting, with graphics and so on, to let the computer to do it all."

Fraser is part of a team researching the interchange of roles in a classroom where a single computer is used for group activities. Findings so far have indicated that the use of certain programs with primary school students results in a shifting and sharing of manager, task setter, explainer, counsellor, pupil and resource roles, between the computer, teacher and students. This, says Fraser, is "linked to a much more balanced pattern of pupil learning activities, with more problem solving and investigative work and less total emphasis on technical drill."

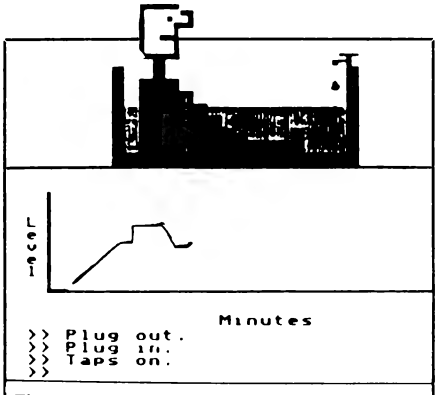
She described the use of one program, called Pirates (see Figure 2), which facilitates role imitation: "Imagine a classroom with 30 pupils, one teacher and one micro placed on one side at the front. The teacher plans to run a session where the pupils will be looking for the best strategy in a situation that has a stochastic (*that is, guessing*) element.

"The scene is one of treasure hunting – each dig for treasure results in information to the treasure hunter in the form of 'clues' on the whereabouts of the treasure. The program can provide five different types of clue, each based on a different area of the mathematics curriculum and each promoting a quite different challenge with respect to the best strategy to adopt in order to find the treasure in the least number of 'tries'."

Thus the teacher begins by setting the scene and introducing the task; the teacher has manager and explainer roles. The pupils begin to discuss the situation; they are acting as fellow pupils. The computer program is loaded and the teacher sets the options such that one of the 120 different types of treasure hunt gets under way. The program selects the hiding spot for the treasure at random; now the computer has adopted the manager and task setter roles, so the teacher is free to become a fellow pupil, and the pupils can even take on the role of managers. While the game is being played the students are recording data given by the computer on their own co-ordinate grids, so everyone participates. Both pupils and teacher will take on explainer roles as they become more intrigued by the strategic challenge.

Says Fraser, "You can thus picture how the whole class in discussion can proceed with some enjoyment in tackling the problem together." This kind of work is facilitated by a program which leaves something for all class members to do; although Pirates is all about plotting points, lines and regions, it never displays a graph or plots a point – this is left to the students.

Fraser also described the use and effects of Eureka, a program designed to develop skill in interpreting and sketching cartesian graphs of realistic situations. In this case the situation is that of a man taking a bath (see Figure 3). The screen shows a cartoon of the scene, which is controlled by the teacher using keys like 'T' for 'tap' on/off, 'P' for 'plug' in/out, and so on. Beneath the cartoon a graph plots water against time as the scene progresses.

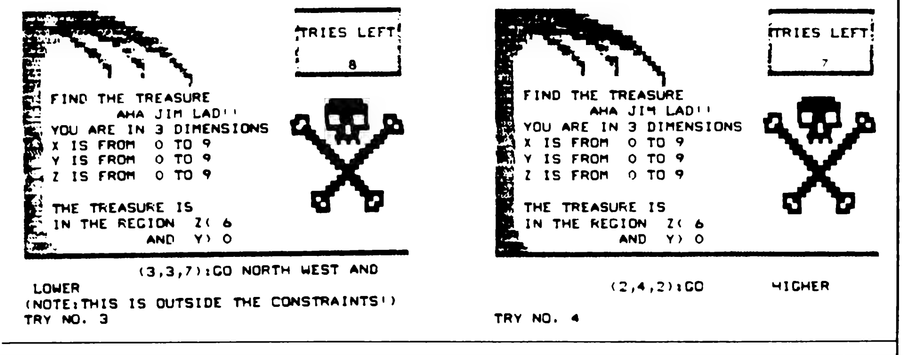


```
>> Plug out.
>> Plug in.
>> Taps on.
>>
```

Figure 3. Eureka – the graph represents the water level in the bath.

From watching this program in classroom use, researchers have observed that the computer is treated as an independent personality. Says Fraser, "This is an invaluable illusion, creating learning situations which feel 'open' to the students, but comfortably 'closed' to the teacher." While the computer acts as a teacher's 'assistant' and takes over a major part of the teacher's normal load in the classroom, the teacher is also free to give attention to other crucial but neglected teaching roles, which, says Fraser, "are assumed by teachers in a natural way under these conditions."

What Fraser calls the 'omission design' of Eureka ensures the most important things are done by the students. She explained, "Eureka used as above enables the teacher to make clear in a lively, amusing way how cartesian graphs work. The students are interested, but passive – we call it 'gawp mode'. The quality of learning activity rises sharply when either cartoon or graph is turned off, the students being asked ▷



```
FIND THE TREASURE
        AHA JIM LAD!!
YOU ARE IN 3 DIMENSIONS
X IS FROM  0 TO 9
Y IS FROM  0 TO 9
Z IS FROM  0 TO 9

THE TREASURE IS
IN THE REGION  Z( 6
           AND  Y) 0
            (3,3,7):GO NORTH WEST AND
LOWER
(NOTE:THIS IS OUTSIDE THE CONSTRAINTS!)
TRY NO. 3
```

```
FIND THE TREASURE
        AHA JIM LAD!!
YOU ARE IN 3 DIMENSIONS
X IS FROM  0 TO 9
Y IS FROM  0 TO 9
Z IS FROM  0 TO 9

THE TREASURE IS
IN THE REGION  Z( 6
           AND  Y) 0

                (2,4,2):GO       HIGHER

TRY NO. 4
```

Figure 2. A short sequence of events in the 'Pirates' game.

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either to sketch the graph or describe the scene – working in pairs, groups or in a class discussion."

Variations on a Theme

Chris Bigum (of Deakin University, Victoria) and Peter Frey (of Christ Church Grammar School, South Yarra) described a program which produces a variation on the role-playing theme. Hunters and Gatherers is a computer-enhanced role-playing simulation of life in traditional Australian Aboriginal culture. Designed for use as part of the social studies curriculum, to give insights into the functioning of a hunter/gatherer society, this program was also found to contribute to the development of skills such as planning, co-operation, and hypothesis formation and testing.

Frey listed the tasks performed by the program as followed:

1. The computer generates a map (20 by 20 locations), which is a construction of inter-related terrain types. For example, the dry river beds flow out from the region of impassable mountains.
2. Using the map, the computer sets up a particular game scenario: the mobile animal population is distributed to appropriate regions (for example, kangaroos to grassland); the computer determines the initial population of the four tribes or groups acting in the simulation; the age and sex of the members of each group are determined; and so on.
3. Usually, as an introduction to the program, the students using the simulation determine the name of their tribe and the names of the individual members of their tribe. This information is stored as a preliminary to actually using the simulation.
4. The simulation itself operates by maintaining a record of all the game variables; that is, animal populations, births and deaths in each tribe, food requirements, use of the environment, and so on. The program also monitors all the 'actions' each member of the tribe takes. These actions include moving, looking, hunting, gathering, making (tools and weapons), taking (resources or any item left in the region), sharing (food with other tribe members), or attacking (members of other tribes).

The students are free to do whatever they like within the constraints of the simulation. As they become more familiar with these constraints and more proficient in manipulating the variables of the simulation, they develop insights into the culture. The activities carried out on the computer can be complemented by other classroom activities, such as constructing models of campsites and tools, and writing myths and legends for the culture.

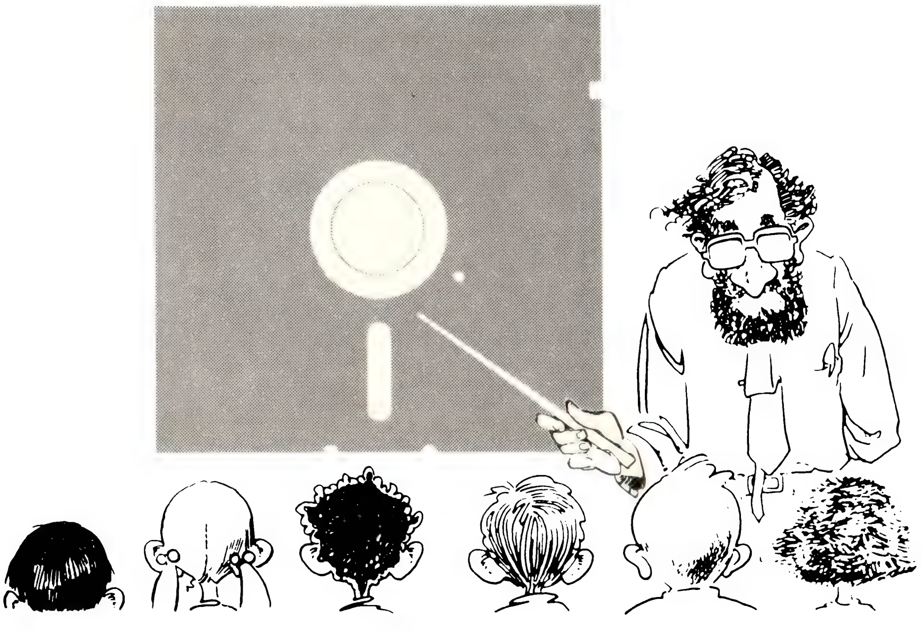
This type of program, which encourages students to explore a topic and learn from their own mistakes, is becoming increasingly popular. It allows a means of absorbing information virtually insupportable in the traditional classroom situation – teachers don't have the time to let children reach their own understanding of a subject, and so must often resort to feeding their classes facts, the truth of which was discovered by someone else.

Microworld Teaching

In a second paper for the ACEC, Chris Bigum, in conjunction with Tony Gilding (Melbourne CAE), outlined the use of 'Atom Alchemy: A Content-based Microworld'. The teaching philosophy behind a microworld is similar to that of the simulation described above. The most significant feature of a microworld, according to Bigum and Gilding, is "that the environment is one in which there is a high degree of learner control. In particular, the rules, goals and criteria for success are in the hands of the learner. Under these conditions, what is to be learned and the ways in which the learning is to occur are often not specified or wholly predetermined by the designer, but depend almost entirely on what the participants decide to do and the way in which they arrive at those decisions."

The program Atom Alchemy, then, allows students to develop an intuitive understanding of the basic concepts of atomic structure, and to become familiar with the associated chemical jargon. Says Bigum, "The microworld is based on a simple 'building model' of atomic structure. The user is able to construct atoms and ions by 'adding' or 'taking away' one or more protons, neutrons or electrons from a given initial atom which has a low atomic mass. Stable or 'good' combinations of protons, neutrons and electrons are obtained when the learner is able to manipulate the microworld to satisfy two conditions: 1) A stable proton/neutron ratio; 2) The number of protons and electrons is equal or results in the charge of a stable ion. From the learner's point of view this

▷



means making an atom or ion with a 'good' nucleus and a 'good' charge.

"If the atom or ion is unstable, the program represents the 'decay' of that atom or ion. The decay represented is the decay expected of the particular atom or ion. Decay continues until a stable combination is reached, or until the learner intervenes during decay to change the combination of nucleons. If the learner's action results in a stable atom or ion, the program provides some information about what has been made."

The structure of atoms is traditionally learned by rote, but the microworld enables students to research the content; to form their own rules and develop their own hypotheses, which enable them to 'discover' atoms and ions.

Enhance the Learning Process

Sandra Wills, co-ordinator of computer education for independent schools in Victoria, also emphasised the computer's ability to enhance the *process* of learning, not just the content. In presenting a paper entitled 'Doodle, Design, Debug' at the conference, she talked about programs such as Logo, word processors and databases as tools which let you "doodle till you get something that sparks your interest, then go off on a quest with a design to find out, and then debug your theory."

She gave the First Fleet educational database – produced by the Elizabeth Computing Centre in Tasmania, and which contains information on the passengers of the first fleet of ships to arrive in Australia – as an example of how children could learn *with* computers rather than *from* them. She says, "Instead of reading a book about convicts which tells the student what the author thinks, you're giving the students the opportunity to ask questions and find out for themselves."

The First Fleet contains 13 items of data on each of the convicts who arrived with the first fleet. "The data," explained Wills, "can be quickly accessed, collated, counted and selected according to the request you type on the computer, if it is a suitably phrased request. For example, SURNAME=JONES will select in a matter of seconds all convicts with the surname of Jones."

She said in doodling with the database students might type in something like CRIME=MURDER, which causes great surprise when the computer draws a blank. "This may spark off a concentrated investigation of why there were no murderers and which were the worst crimes for transported convicts. The learners will progressively debug their design, testing related requests of the database until they find a satisfactory conclusion to fit their hypothesis.

"The content of the database," she added, "can be anything from New South Wales bushrangers to scientific observations in Antarctica or census records, but what is important is the methods the students employ to solve problems and learn for themselves from the data that is available to them. And the teacher's role is to guide their understanding of search strategies and problem solving."

In Tasmania teachers have been using the school computer network to encourage children to look critically at the information they receive from the media. Through the network every school has access to a major world news service, and the children can compare the raw news to what they read in the papers, see on the television, or hear on the radio.

Sandra Wills also spoke about Logo (see the review of Extended Turtle for an explanation) in terms of the 'Doodle, Design, Debug' strategy, saying, "At the lowest level of Logo, you could just be experimenting with moving the cursor forward, back, left and right – 'doodling'. Kids can quickly get bored with this, so you can give them a 'design', by getting them to find their way out of a maze (drawn on a transparency which is placed over the screen). Then they can

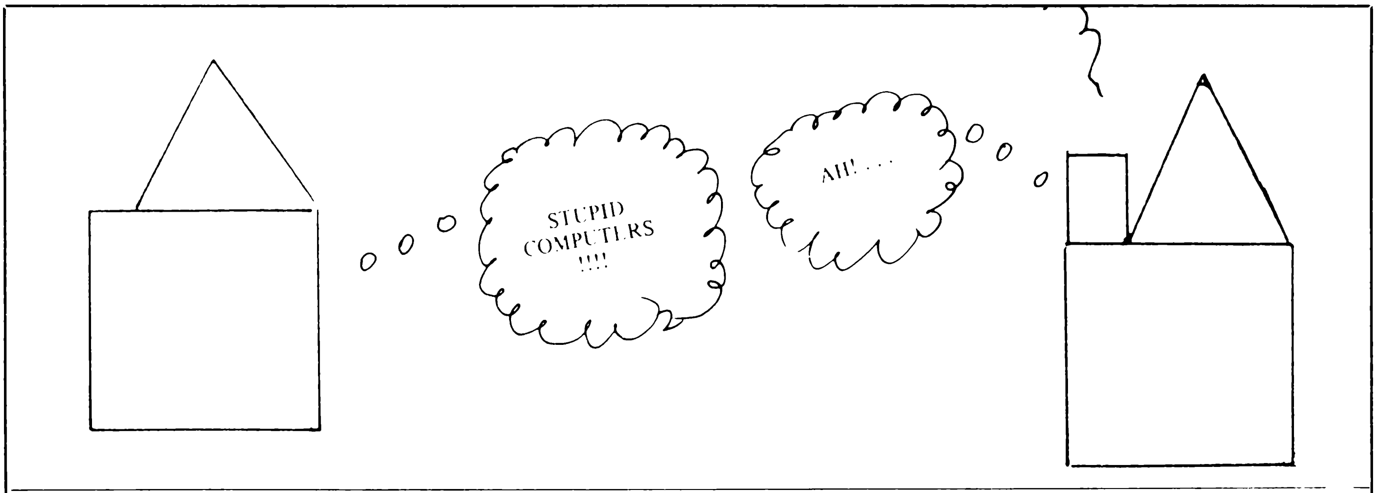


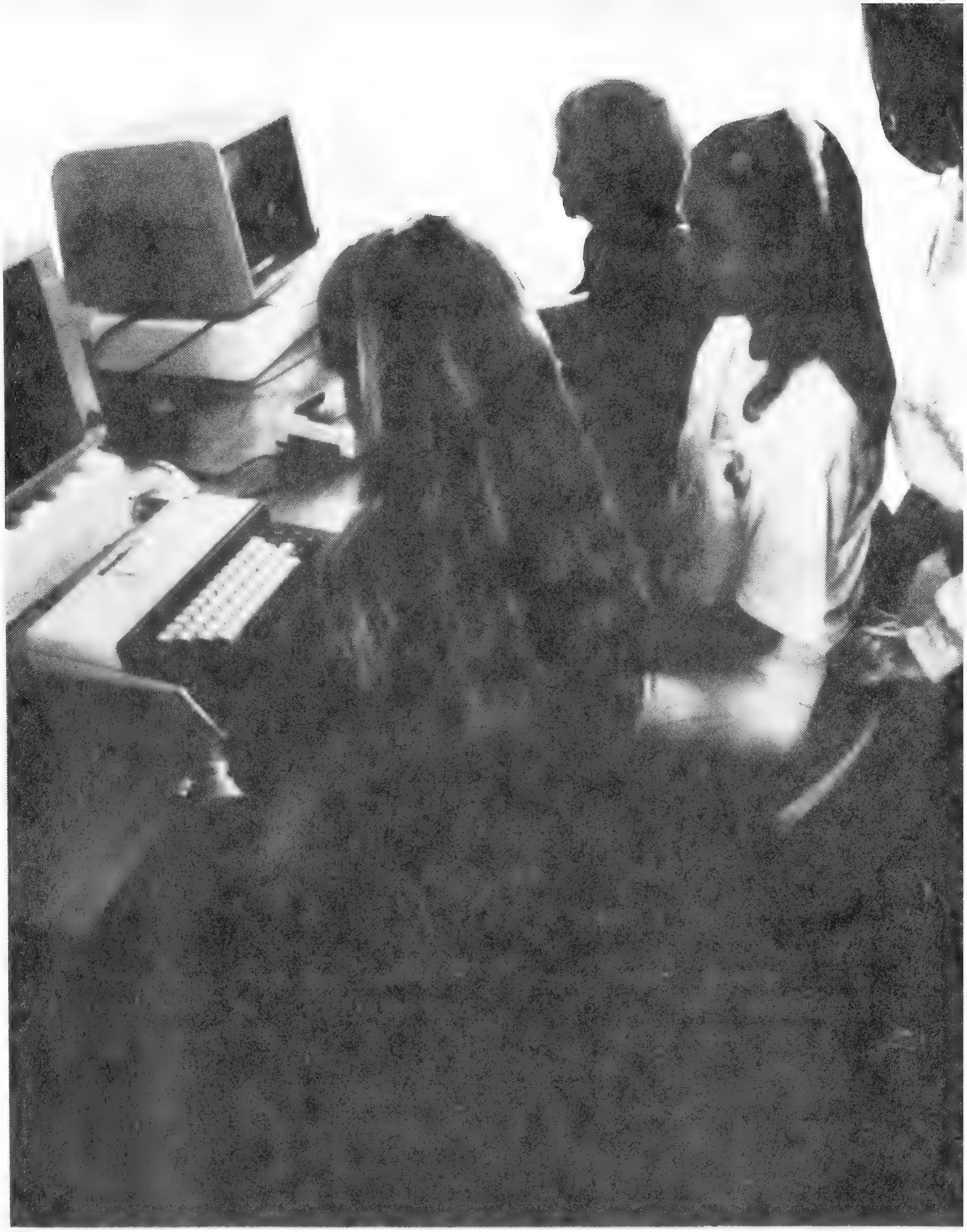
Figure 4. Sandra Wills, co-ordinator of computer education for independent schools in Victoria, believes computers can benefit children in encouraging them to follow a process of 'doodling, designing, and debugging'.

The drawings shown here were done with the Logo program. The child might have doodled and familiarised him or herself with the way the program works, and then come up with a plan to draw a house. The plan obviously wasn't perfect, so the miscalculations led to modifications, or 'debugging'.

formulate their own design – draw something; they'll probably make mistakes which they can then debug (see Figure 4). With Logo you can teach spatial awareness, maths and geometry, computer literacy, art and creativity, and computer programming."

Many other imaginative uses for computers in education were discussed at ACEC. Several teachers, for example, cited adventure games as great generators of worthwhile classroom activities. It was Roger McShane of Tasmania's Elizabeth Computing Centre who said, "I believe some of the best educational uses of computers in primary schools have come from adventure games." He supported this by relating, "We've had groups using these and the kids tried to beat each other through the game; they started to keep log books, started to write about what they'd done, started to talk to each other more effectively, started to act out scenes as they imagined they would happen in the game."

McShane supported Rosemary Fraser's view, saying, "The work you do away from the computer is just as important, if not more important, than what you do at the computer. The computer can be a great stimulus."



Still Room for Drill and Practice?

Despite the emergence of such innovative thinking in regard to educational computing, most teachers agreed that there was still a place for 'drill and practice' programs in the classroom – at least in primary and infants' schools.

Helen Richards, from Denistone East Public School in New South Wales, said teachers of Years 1 and 2 at her school had been using drill and practice programs for some time, and "have found them ideal for use in the consolidation of basic skills." She continued, "Many arguments have been put – and will continue to be put – for and against the value of drill-and-practice-type programs. In our infants department teachers utilise a range of data entry programs which allow children to practice skills relevant to their class work." And, she added, the children continued to work in this manner with "undiminished enthusiasm".

Suzanne Ziems, also a teacher at Denistone East, said the advantage of drill and practice programs is that, "If a child needs to practice the same skill again and again he or she doesn't feel bored doing it with a computer."

The most common method of using drill and practice software seems to be to roster individual children to go to the classroom computer at specific times of day when the teacher is not actually teaching and the students are involved in other activities. The most popular programs take the student through maths or spelling exercises, and the best of these are programs which allow the teacher to individualise the exercises given to suit children of different abilities and needs.

Use is All

There is a huge range of educational software on the market – some dreadful, some brilliant – and there's also a great deal of software which is not specifically educational but which can be used in the classroom and at home to benefit students. The deciding factor in whether or not a program will achieve anything seems to be how it is used – so teachers needn't fear that they'll become irrelevant when computers come into the classroom. ■

Much of the information quoted above was taken directly from the Second Australian Computer Education Conference papers, all of which are published in the Conference handbook, entitled 'Computers and Education – Dreams and Reality'. The handbook may be obtained from the Computer Education Group of New South Wales, PO Box 148, Broadway 2007, for the post-paid price of $20 -- it makes interesting and helpful reading for anyone interested in the role of computers in education.

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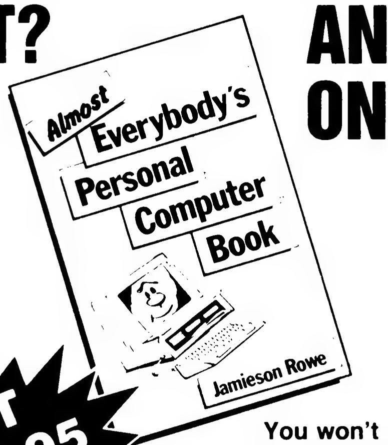

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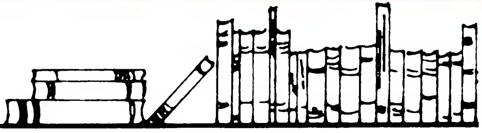


Courseware Cross-Section

DesignWare
Crypto Cube
Word Attack!
One World
Raft-Away River
Senior School Science
Memory Match
Computer Tutor Basic Arithmetic and Algebra
Volcanoes
Alien Addition
Long Division Made Easy
Bank Street Writer
Word Master Educational Software
Dragon Mix Educational Software
Spellicopter
MasterType The Typing Instruction Game
Verb Viper Educational Software
Monkeymath It All Adds Up To Fun
Crossword Magic
Meteor Multiplication Educational Software
Minus Mission Educational Software
Shape and Color Rodeo Early Childhood Software
Subtraction Made Easy
Infotainment
Puzzles
Games
Sports
Quizzes
Analogies
Cunning Running
Playful Professor
Shop

How do you evaluate an educational program? As you might have read in the previous article, a great deal depends on how you want to use it. The reviews collected here should give you good idea of what experienced software evaluators and teachers look for in a package, and of the diversity of products available on the market.

Courseware Cross-Section

For those interested in any of the programs displayed on the previous page, we've provided a key to suppliers and prices.

THE FOLLOWING packages by DLM and Hartley are distributed in Australia by Dataflow Computer Services, 6-8 Elizabeth Street, Burwood 2134; phone (02) 745 3303.

1 **Verb Viper:** In this program an elastic-necked creature from the swamps helps children master subject agreement, with regular and irregular verbs, in present and past tense and as past participles. All DLM programs allow children to regulate the speed of the program, choose from different levels of difficulty and vary the running time of the program. Price – $49.95 for IBM-PC and Apple machines, and $35.95 for the Commodore 64.

9 **Word Master:** This program gives students practice in identifying pairs of antonyms, synonyms and homonyms. It's a race against time. Price – $49.95 for the IBM-PC and Apple machines, and $35.95 for the Commodore 64.

10 **Memory Match:** A game in which students can play against themselves, another student, or challenge the computer. The user can choose from 25 lessons at three levels of difficulty. Word pairs include homonyms, number words, rhyming words and contractions. Price – $35.95 for Apple machines.

14 **Dragon Mix:** A large dragon protects the city from invading forces, and also gives students practice in multiplication and division facts. Price – $49.95 for the IBM-PC and Apple machines, and $35.49 for Commodore 64 and Atari computers.

19 **Meteor Multiplication:** Master basic multiplication facts and zap the meteors moving towards the star station. Price – $49.95 for IBM-PC and Apple machines, and $35.49 for the Commodore 64.

20 **Minus Mission:** Students practice basic number facts. Their reward? Destroying "large green blobs of dripping slime." Price – $49.95 for the IBM-PC and Apple machines, and $35.49 for the Commodore 64.

21 **Analogies:** A two-disk program with which students learn to identify types of analogies. The program provides hints or explanations in response to incorrect answers, and the lesson content may be modified to offer a continuous challenge. Price – $49.95 for Apple machines.

27 **Shape and Colour Rodeo:**This program offers six different games in which children are asked to mix and match shapes and colours. Price – $39.95 for the IBM-PC and Apple machines, and around $29.95 for the Commodore 64.

The second group of programs, produced by a number of different educational software companies, is distributed by Imagineering, 579 Harris Street, Ultimo 2007; phone (02) 212 1411.

2 **Spellicopter:** A program from DesignWare in which children are asked to pilot a helicopter "through crowded skies, above mountainous terrain, to rescue the letters of the secret words." You can create your own spelling lists and clues. Price – $59.95 for Commodore 64, and Apple IIe and IIc.

4 **One World Countries Database:** See the review on following pages.

5 **Math Maze:** Another DesignWare program, in which the user must grab the right answer to the math problem while racing through the maze. Gives practice in addition, subtraction, multiplication and division. You can select from 40 prepared mazes or make your own. Price – $59.95 for Apple II, IIe and IIc.

6 **Bank Street Writer:** The well-known word processor for children, from Broderbund Software in the US. Price – $99.95 for Apple II, IIe and IIc machines, and $79.95 for the Commodore 64.

Math Blaster: From Davidson and Associates in the US, this program contains over 600 problems in addition, subtraction, multiplication, division, fractions and decimals, for students aged six to 11. Parents and teachers can enter additional sets of programs. Price – $69.95 for Commodore 64 with disk drive, and $69.95 for Apple II, IIe and IIc.

11 **Cryptocube:** Also a DesignWare product, Cryptocube asks the user to find "the hidden words in the three-dimensional puzzle." A built-in puzzle generator turns your own word lists into puzzles. Can be played by one or two people. Price – $59.95 for the Commodore 64, and Apple II, IIe and IIc.

12 **Word Attack:** Word Attack comes from Davidson and Associates and contains a total of 675 words in sentences illustrating their usage. Students can select from a variety of exercises, including an arcade game, to help them learn. As with most of the software distributed by Imagineering, you can enter your own learning material. Price – $69.95 for Apple II, IIe and IIc machines, and for the Commodore 64 with a disk drive.

15 **Computer Tutor Basic Arithmetic and Algebra:** Learners are taken step by step through the Arithmetic and Algebra contained in the syllabus for the New South Wales Higher School Certificate. Price – $79.95 for Apple II, IIe and IIc.

16 **Computer Tutor Sentence Construction:** Similar to the above program, but here the tutorial is in English sentence construction. Price – $79.95 for Apple II, IIe and IIc.

18 **Crossword Magic:** A very popular program with teachers, Crossword Magic will create a crossword puzzle for you using your words and clues. The puzzle can be displayed on the screen, or produced as hard copy using a graphic printer. Price – $84.95 for Apple II, IIe and IIc.

26 **Print Shop:** This package allows you to design signs, forms, letterheads, certificates, bookplates, posters, cards and so on, with a range of typestyles, border designs, and pictures. From Broderbund Software, it costs $69.95 for Apple II, IIe and IIc machines.

From Spinifex Software (20 Binda Street, Keiraville 2500; phone (042) 27 0788 came:

3 **Long Division Made Easy:** Written for children in upper Primary and lower Secondary years, this program addresses the problem of developing confidence in applying the long-division process. The aim is to show that even the most complex long-division problem can be completed by the step-by-step

application of simple operations. Price – $49.95 for Apple II+ and IIe.

28 **Subtraction Made Easy:** This program is written for children in the lower Primary years and aims to develop confidence in applying the subtraction process. Price – $49.95 for Apple II+ and IIe.

Two of the programs came from Jacaranda Wiley's range of educational software. The company may be contacted at 65 Park Road Milton 4064; phone (07) 369 9755.

8 **Raft-Away River:** This is an adventure simulation which is said to "provide students with an opportunity to develop skills in reading comprehension, effective communication, co-operative behaviour and problem solving. For use in groups of two to six children. Price – $49 for Apple IIe and IIc machines, and for the BBC Micro.

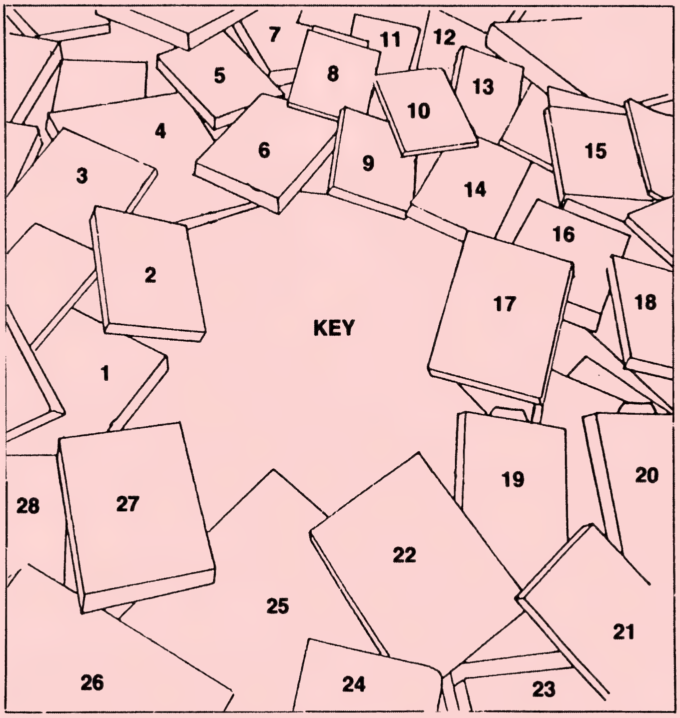
24 **Cunning Running:** One of a suite of programs that have been written to complement*Moving into Maps*, the pre-atlas book in the Jacaranda Atlas Programme. For use by students from seven to 13 years of age, the program can also be used on its own in a classroom where basic map concepts are being taught. Price – $45 for Apple IIe and IIc machines, and for the BBC Micro.

From Applied Technology – 1 Pattison Avenue, Waitara 2077; phone (02) 487 2711 – came:

13 **Senior School Science:** See the review in the following pages.

And Ozi Soft – 33/8-24 Kippax Street, Surry Hills 2010; phone (02) 211 1266 – supplied us with:

Monkey Math: From the Artworx Software company in New York, this program is said to couple the fun and excitement of an arcade game with the opportunity to learn and practice number placement, addition, subtraction, multiplication and division. Price – $29.95 (on cassette) and $34.95 (on disk) for the Commodore 64.



22 **Kids Say the Darndest Things to Computers:** In this program from Infotainment in the US, radio and TV personality, Art Linkletter, asks the children questions and uses their answers "to create wonderful and hilarious stories." Price – $29.95 (on disk only) for the Commodore 64.

23 **Playful Professor:** This maths tutor has a magic castle with a ghost dancing from room to room holding a golden key. Each correct answer to a maths problem (addition, subtraction, multiplication and division) brings the child closer to taking the key and escaping the castle. Price – $34.95 (on cassette) and $39.95 (on disk) for the Commodore 64.

Genetic Inheritance

Reviewed By
Ken Baum-garner

Senior Tutor,
School of Education,
Macquarie University

THIS cassette incorporates two related programs for biology and science students of 15 to 18 years of age. Both programs were written using the Word-a-Bee authoring system, which allows students to backstep through the program to review previous work.

Side One, 'Hum In' (Human Inheritance), deals with six human genetic characteristics. Its loading time is about seven minutes, and it seems to be well presented and able to be used by the age group for which it is intended.

Tribes Are the Norm

The user can study monohybrid cross and dihybrid cross patterns. The assumption is made that families have large numbers of children, and that F1 offspring are genetically identical when producing the F2 generation.

Although a printer is not needed for the display of data, there is a facility in the program to dump the data onto a printer for analysis.

One limitation of the program is that only two generations can be analysed, thus making it useful only for introductory studies in genetics. Another feature which might have been included is a summary statement of the data generated, so a visual analysis could be done if a printer is not available.

Mendel's Theories

Side Two of the cassette, entitled Mendel, simulates and tests the validity of results obtained by Gregor Mendel. It is designed along the same pattern as the Hum In program, except the user chooses dominant and recessive characteristics for the experiment. The final part of the program suggests the users compare their results with Mendel's data, so it would be essential for students to be familiar with Mendel's laws.

The limitation again is that students can only work with F1 and F2 generations. Mendel would be a useful aid for students working through a workbook on Mendelian genetics, as long as the two generation limitation was acknowledged. The loading time is about six minutes.

Genetic Inheritance is produced by Honeysoft, a division of Applied Technology (1a Pattison Avenue, Waitara 2077; phone (02) 487 2711), and costs $12.50. □

Courseware Cross-Section

Ashton Scholastic

IT HAS, (I must be Frank) been some years since I caught the ol' school bus. No longer do I join tuckshop queues at recess and lunch. Yet the theme of this magazine has conjured memories redolent of wooden desks, each with its two wooden students, and a teacher who wooden hesitate to whop you with his wooden stick. Ah, those happy days. The best days of your life. But certainly, at least for this old feller, days in which 'computer' had only just entered the vocabulary of the English language.

How different now. Each weekday morning my son stuffs his school bag with the skills of a taxidermist. Text books, half-finished homework, sports gear, food rations for nearly seven hours, and the Computer Kit. The contents of this latter reflect the shared interests of this newly-aware generation; newly-aware, that is, of computers and their trappings.

The school-age Computer Literate totes a variety of computing magazines. *Your Computer* is naturally compulsory reading. A few back copies of Ashton Scholastic's *Classroom Computing* are packed carefully about a half-dozen floppy disks bearing the grubby fingerprints of numerous other Computer Literate colleagues.

The term 'Computer Literacy' is currently 'in'. We all know what it means. Or do we? Whatever it is, it would seem most parents are keen to ensure that their children become Computer Literate. Their rationale takes various forms, but high on the list is the idea that job or educational opportunities are significantly better for school-leavers who possess this mysterious quality.

Here I've reviewed five software items from Ashton Scholastic, a Gosford-based company representing Scholastic and a number of other overseas software organisations in Australia. The packages reviewed were designed for the Apple II, but may also be available for Atari and Commodore.

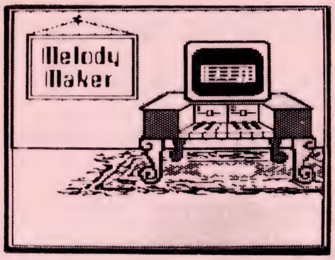
A few remarks about Scholastic itself are in order. The company publishes over 100 million books and 200 million classroom magazines each year. It claims to reach every child in the United States, and many in Australia, at least once a year. Scholastic is also responsible for a range of educational television series, some of which have been shown here on commercial channels. High on Scholastic's list of priorities is its educational software program, targetted for both the classroom and the home.

For further information on the following and other Ashtron Scholastic products, write to Ashton Scholastic, PO Box 579, Gosford 2250; or phone (043) 28 3555.

Microzine

THIS IS a strangely packaged micro-equivalent of what some of our Very Old Readers may recall as the *Boys' Own Paper*. That was the original Penny Dreadful; a combination of yarns, mystery and adventure. It had how-to articles and puzzles. And it was very, very popular. Of course, that was long before television. Indeed it was contemporaneous with the early days of radio. My dad collected a heap of them over the years, passing them on to us Little Lees when he thought they might do us some good.

Press RETURN to continue



Here then, is BOP Revisited.

First, a word about its presentation. An example of Scholastic's "Wizware", it comes in a rather odd rhombus-shaped box containing a similarly shaped manual. Fortunately, the single floppy disk also contained within the box is square. The disk is double-sided, a practice which I abhor, particularly when used with single-head drives.

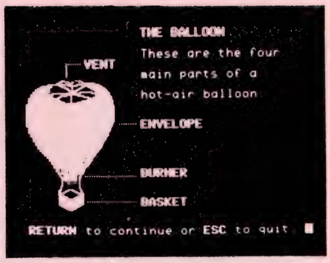
This particular issue is Microzine Volume 1 Number 2. The label indicates that its target is children aged ten or older, who have access to an Apple II Plus (or IIe) with 48K and a disk drive. Like any normal magazine, it has an index. Since the software is very clear in its instructions, one gets the impression that its rhomboidal manual is superfluous. The graphics, like the colour plates of old BOP, are delightfully executed. I imagine that a ten-year-old would gain a great deal of fun from Microzine, but perhaps not much from an educational point of view.

Not in the Course

Not that I wish to be negative. Indeed, any environment which requires the exercise of problem-solving skills has a distinct educational value. The point which I am trying to make here is that the Microzine content is not related to normally accepted educational course material.

The disk contains seven sections:

- What's Inside – a summary of the next six sections.
- Northwoods Adventure – an interactive Adventure-style game combined with impressive graphics.
- Melody Maker – uses the computer to create, edit, record, and play back single-Apple's built-in speaker).



THE BALLOON
These are the four main parts of a hot-air balloon

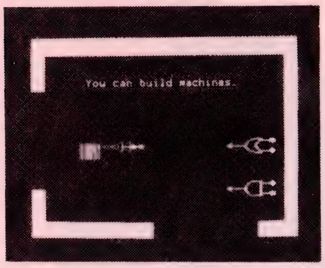
RETURN to continue or ESC to quit

- Computer Stuff – painless instructions for formatting a disk to be used for saving melodies and word ladders.
- Ride the Wind – an interactive game in which you pilot a hot air balloon in a 'hares and hounds' simulation.
- Word Ladder – a familiar game in which the player begins with one word, then transforms it one letter at a time to become another target word, such that all intermediate words are valid.
- What's Next – a peep into the contents of the next issue.

Word Ladder would have some value in vocabulary building and spelling. I found the hot air balloon game just plain infuriating. I fancy myself as an armchair pilot, but managed to prang the rotten thing every time. This is clearly a job for Number One Son.

Melody Maker, although simple in concept and execution, could have a real value in introducing the principles of music notation to students.

In summary, a well presented recreational item with a modicum of educational value. The price list from Scholastic indicates that six issues of Microzine have been produced so far. Each issue costs $49.95.


You can build machines.

Rocky's Boots

WHAT'S in a name? The name of this particular offering provides not the slightest hint of what it's all about. Who would guess that this is a software counterpart of those logic prototyping kits designed to teach students about logic gates, flip-flops and delays?

There was a time when such subject matter was an integral part of all courses in computing. Students were shown how elementary gates could be hooked together to form more useful goodies like a half adder, a multiplier, or a byte translator. Lift control or traffic light logic boxes were also common class examples. The last five years has, however, seen a decline in interest in these subjects (outside of engineering courses). No doubt this is due to the corresponding shift at the hardware level away from discrete component logic to the more economical VLSI (Very Large Scale Integration) chips such as the microprocessors which now replace tens of thousands of elementary logic circuits.

Fascination for Innards

Nevertheless, there remains for most school-age children a fascination with the 'inner workings' of the computer. Personally, having been through the process of grappling with discrete logic in my earlier days, I feel that a package like Rocky's Boots can go a long way to satisfying that curiosity. It would be a grave mistake to short circuit an early interest in such things by explaining that they are now taken care of by complex integrated logical devices. This would be to repeat the error of earlier times when the computer was seen as a mysterious black box, understandable to just a few, select, white-smocked, myopic and balding gurus. Rocky's Boots is perhaps just enough to answer questions about computer logic for today's young enquiring minds.

A purist might object to the lack of NAND and NOR gates from Rocky's collection of goodies. But his box of ANDs, ORs and NOTs forms a (mathematically) complete set of functions which can be used to build *any* logical construct. Rocky's box also contains wires, flip-flops and delay circuits, any of which can be picked up and assembled using the keyboard or joystick. You can pop a TRUE signal in at one end and watch its progress through a network of logical boxes. The state of each input and output is displayed in colour. Even the wires glow to indicate that they are carrying a logical TRUE.

To liven things up, you get three controllable 'devices'. In a 'live' logic box you would expect to find solenoids, indicator lamps, and perhaps relays which could be used to control heavy current devices. Instead, this program provides you with a variety of bells (you can see and hear the clapper clanging), a rocket motor, and ... Rocky's electric boot. Naturally, you would expect a bell to clang when hit with a TRUE. The boot, on the other hand (foot?), does a great kick. There is also an inexplicable green alligator which wanders around the screen, occasionally getting in the way, and breaking up into floating components.

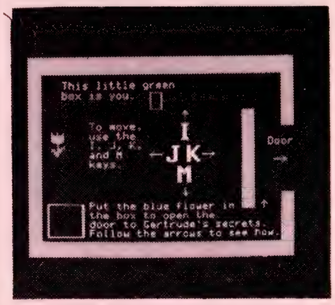
Incidentally, Rocky is a raccoon who pops out and does a jig if you solve one of his logic games.

The Challenge

A variety of sensors is provided. These react to the presence of shapes or colours which can be made to pass by in sequence. The challenge is to build a device which can selectively kick specified marchers in the parade of objects.

Although we 'grown-ups' may regard logic boxes as something reserved for early tertiary education, the presentation of Rocky's Boots makes it most attractive to children in the early years of primary school. The slim manual supplied with the disk suggests the package is for "kids aged seven and up". I see no reason to dispute this. The graphics are well designed, the explanations are clear and often repeated in different forms. A game theme also helps to increase the student's involvement.

For schools with Apples, this item should at least be in their program library. The requirements are Apple DOS 3.3, 48K and autostart ROM, and the diskette and manual cost $69.95.



This little green box is you.

To move, use the I, J, K, and M keys.

Put the blue flower in the box to open the door to Gertrude's secrets. Follow the arrows to see how.

Gertrude's Puzzles

THIS offering is packaged in the same simple way as Rocky's Boots. The label describes it as "An inspired puzzle/maze that challenges children and adults alike with increasingly complex logic concepts. Ages six and up."

On booting the disk (sorry, Rocky), the initial menu displayed is almost the same as that for Rocky's Boots. Provided your six-year-old can read, he/she should have little difficulty navigating the 'self' box from 'room' to 'room', using either the keyboard or joystick. Each room contains a puzzle. On entering a new room, the room plan occupies the whole screen. This is one of the most painless ways I have yet seen for option selection.

Goosie Goosie Puzzle

To start, the player gets Gertrude (a goose) from her nest and releases her in the selected puzzle room. The puzzles are classified into 'loop' puzzles, 'network' puzzles, and 'box' puzzles. Three doors labelled with these options lead from Gertrude's room. Off each puzzle room is a 'how-to-play' room with sample solved puzzles. When the player releases Gertrude, she returns with a collection of objects of various shapes and colours.

The puzzles are deceptively simple logical 'fitting' problems. One must locate each object according to the rules of the game such that the final allocation is a correct solution. A correct solution causes the walls of the room to pulsate with glowing joy, and Gertrude flies in with a present from her treasure room.

The objects in Gertrude's world have colour and shape. There is also a shape-maker sub-system which allows you to design your own puzzles and objects.

The Object of the Game

Loop puzzles teach the basics of set theory. One must allocate the objects without knowing the initial set definitions. Experiments are permitted. Invalid placements cause the object to 'fall' out of the set-loop.

Network puzzles are a little harder. You are presented with a collection of boxes each linked to one or more other boxes by one or two lines. If linked by one line, the boxes must contain objects which differ in only one attribute; if linked by two lines, they must differ in both attributes. The puzzle with six boxes is a breeze. A six-year old might just crack it. Little Franky managed in five minutes. But the network with nine boxes required a bit more thought, although a six-year-old might do it by trial and error.

Box puzzles require you to allocate the objects such that no attribute may appear more than once in any row or column. A three by three puzzle is naturally a cinch. But the four by four was a real embarrassment. Try it yourself. Sixteen objects

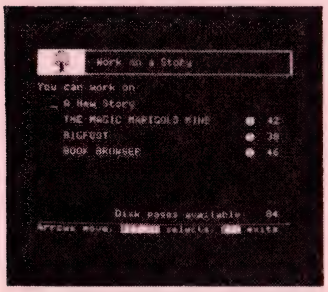
▷

comprised of four shapes, each being represented by four colours, are to be allocated in a four by four matrix subject to the non-collision rule given above. I suspect that this is a special case of the magic square problem. I gave up after my wife solved it in seconds on paper; but then, she's a four-unit maths teacher, so she should (grumble, grumble).

In Context

Linked with class material dealing with sets, this little package might have some value in reinforcing concepts by example. While the execution of the idea is good, the challenge of the program is gone once the puzzles have been solved. One is left with the feeling that the same concepts could be communicated with simple pencil and paper examples.

As far as its application in schools is concerned, perhaps a program which provides each student with a short period of stimulation is better than one which is so absorbing that only a small percentage of the class manages to reap its benefits. Gertrude's Puzzles costs $54.95.



```
Work on a Story
You can work on:
 _ A New Story
   THE MAGIC MARIGOLD MINE      ● 42
   BIGFOOT                      ● 38
   BOOK BROWSER                 ● 46

          Disk pages available:   84
Arrows move, [illegible] selects, [illegible] exits
```

Story Tree

Story Tree ($49.95 on disk) is a program for writing and reading 'interactive' stories similar to the NorthWoods Adventure story mentioned in the Microzine review.

My first reaction was "Where's the educational value in this?". Yet Alistair Campion (Ashton Scholastic) assures me that this particular program is in great demand by school teachers. It is clearly an excellent tool for developing written expression, and for language development. To create multi-strand stories on paper would require considerable skills of management, which could detract from the intended exercise of story composition. Besides, although such stories have been presented in book form for many years, a computer presents the story with far greater impact.

Several Computers Required

To make effective use of Story Tree, the class should have access to a reasonable number of Apple computers. Story composition takes time, and even if the teacher arranges for three or four students to each machine, scheduling problems will quickly arise if the student/machine ratio is higher than five.

The Microzine NorthWoods Adventure contains high-res graphics which are not supported by Story Tree. You can, however, print stories

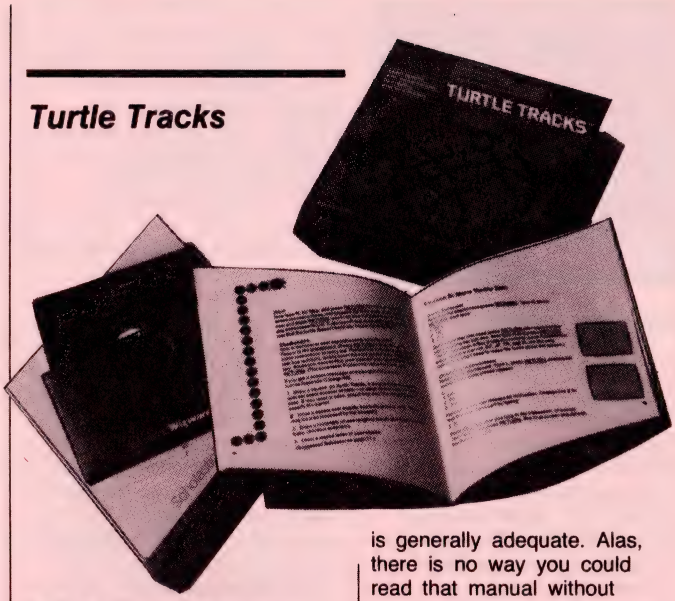
Story writing is done using a small set of easily learned word processing commands. The program maintains the tree structure of the story, and aids the writer in navigating the tree structure to completion.

To fully appreciate a package such as this it would be necessary to write at least one short story with a few options. I chickened out after assessing the time involved. Instead, I selected the first option 'Read a Story'.

The examples supplied on the 'Story Disk' included 'The Magic Marigold Mine', 'Bigfoot', and 'Book Browser'. The third looked the most interesting, and indeed I was right. Perhaps this could be used by the school librarian to prepare reviews of new books which have come into the library. It allows the student to follow a series of selections, to find a book dealing with a particular topic in a particular way. I imagine disk size would be the limiting factor in using such an application, although disks could first be classified into basic library categories.

Recommended.

Turtle Tracks



PACKAGED in the same odd form as the Microzine, Turtle Tracks is Scholastic's version of the popular Logo language. Aimed at children aged "nine and up", the booklet promises that you will "learn to write your own programs by creating your own designs".

As with the other Scholastic packages reviewed here, the documentation is clear, attractive, and complete. A nine-year-old should have no difficulty getting things going.

Although having read a few review articles on various implementations of Logo, I feel a bit disadvantaged by not having played around with Apple Logo, or Digital Research's version. Nevertheless, as an exercise in its own right, Scholastic's Logo requires no outside references.

Masterful Manual

In a manner thoroughly out of character, I decided to read the manual first. How decidedly un-Australian! It is well-designed and easy to read. But, most importantly, it is filled with programming examples, has an appendix of Turtle Instructions (each instruction indexed to a lesson), another appendix showing common programming mistakes, and finally – suggested solutions to the programming "challenges". Although there is no index as such, the Table of Contents is generally adequate. Alas, there is no way you could read that manual without needing to use the Apple as you go. Nor, for that matter, could you simply insert and run the disk without the help of the manual.

The manual (or "handbook") starts with the assumption that the student knows almost nothing about the Apple, let alone programming. Clear instructions are supplied which explain the role of the RETURN key, the backspace key and the cursor during keyboard entry. Complex key sequences are avoided. The control key is never used.

The manual then plunges straight into elementary turtle instructions, but with clear step-by-step examples. The concepts are therefore reinforced at the same time.

The Concept Behind the Turtle

This is not the place to review or describe Logo as such, nevertheless here's a brief explanation of Turtle Track concepts:

The idea is to control a screen object (the turtle) in terms of distance moved, and direction, in order for it to trace some predetermined pattern. The track followed by the turtle may or may not leave a trace on the screen, depending upon whether its 'pen' is down or up. It turns out that to generate patterns with interesting features, one must apply the three basic programming principles of sequence, selection, and repetition. As a result, the child develops a 'feel' for programming principles without the hassles usually associated with computational programming.

The Turtle Tracks language is similar to BASIC insofar as each instruction has a line number which may be referenced by a GT (GOTO) elsewhere in the program. You type R to Run a program, and L to List it. N (New) removes a previous program from the RAM workspace. Lines may be deleted or added as in normal interactive BASIC. Unlike BASIC, instructions cannot be executed in immediate mode since the text screen and Turtle screen are mutually exclusive. Error messages are written in a non-threatening fashion. (Some of us oldies remember beaut bomb-outs on our mainframes with messages like IEHxxxx ABEND – CORE DUMP IN PROGRESS.) When I tried an immediate TR instruction, the turtle replied "OOPS! LINE NUMBER MISTAKE". 'Mistake' is a much more human word than 'error'.

Easy Commands

As a concession to little fingers unfamiliar with computer keyboards, the instructions themselves are as brief as possible, although retaining some mnemonic value. Thus TR means 'Turn Right'. No prizes for guessing what TL means.

On typing 'R' (for Run), the message 'RUNNING' appears, during which time (I presume) some form of semi-compilation takes place. The low-resolution graphics screen then appears, and the turtle does his thing. You return to the text screen by pressing any key.

Following instructions about Drawing Forward n steps (DFn), the student uses TR and TL to solve "challenges" (not 'problems'), such as drawing a square, a rectangle, and even a selected capital letter.

The Jump Forward n steps (JFn) is next introduced. This causes the turtle's pen to be retracted before advancing n steps (n can also be negative). For each new instruction type, a new set of challenges is supplied. The student should now be able to draw a square or rectangle at a chosen place on the screen, to draw a slanted line (45 degrees) and to draw a face. Sample solutions are supplied in the back of the manual.

Looping Concepts

The manual next introduces the 'looping' concept. Naturally, the first example is an infinite loop achieved by putting a GOTO (GTn) instruction at the end of the program. The loop is stopped by pressing any key (remember – no control keys are used).

Incidentally, the supplied example illustrates that the turtle's drawing space is folded top-to-bottom and side-to-side (a topological torus).

A more useful form of loop control is the instruction pair BL (Begin Loop) RLn (Repeat Loop n times). Loops can be nested up to three deep.

The student can follow the execution step-by-step by using the Walk (W) command. Following the W command, the turtle executes one instruction each time the SPACE bar is pressed. The instruction being executed is displayed at the bottom of the graphics screen.

Debugging and Detail

The manual uses this as an opportunity to talk about debugging, and to present new challenges such as drawing a square within a square, or using loops to draw a triangle or diamond.

Following some explanations about program editing, the manual explains how to save and load stored Turtle Track programs. The CATALOG command reveals the presence of some pre-programmed examples.

CATALOG reveals the presence of a program called DEMO. After loading it (LOAD DEMO), it is started by typing R. The turtle draws a cute little house and a tree with blue sky and green grass. Not brilliant high-res graphics stuff, but there are some interesting twists (for example, the computer beeps as it draws puffs of smoke rising from the chimney). Clearly, there is much more to be learned about this language.

To this point the student has been drawing strings of asterisks. A whole range of characters is available, together with foreground and background colours. User-defined ('MicroMode') characters may also be used. These are created on an eight-by-eight slate using the turtle (albeit a micro-turtle) to fill the cells.

Help!

At this point the H(elp) command is introduced. Four help screens (also listed in the manual) supply the codes required to create special characters and colour combinations. A command and instruction summary is also provided.

Sounds of varying pitch and duration can be played. Thus B#20;200 plays pitch 20 for a period of 200 units.

It's not long before the fledgling programmer realises that he needs goodies like variables in which to store current values. This major conceptual hurdle is handled very well, unlike so many texts on introductory programming. The syntax is similar to BASIC's LET statement (without the LET).

The Subroutine that Wasn't

The subroutine concept is introduced naturally as a means for avoiding unnecessary repetition. The word 'subroutine' is never used. Instead, the manual talks about "mini-programs", each of which is identified by a descriptive word such as 'square', 'roof' and so on – a vast improvement on BASIC's GOSUB 2000. Invocation of the mini-program is effected by simply using the mini-program name as if it were an instruction. Individual mini-programs can be checked out without running the main program. Thus, R SQUARE runs the mini-program called SQUARE.

The manual winds up with "Saving and Loading Your Work", "Using a Printer", and the abovementioned appendices.

The use of Logo, or any other language to teach programming skills to children is currently under hot debate. Some writers assert that there is little educational value in teaching programming as such. After all, do we teach (they ask) about electric motors so that people can use devices which contain electric motors? Me old Mum wouldn't know an electric motor if it bit her, but she knows how to use a sewing machine, the blender and a vacuum cleaner (who needs clean vacuums?). That's not a bad argument, but the only thing electric motors and computers have in common is that they both run on electricity. An electric motor in the refrigerator is a special purpose engine. The computer is anything but. In olden times, we called them 'general purpose computers' to distinguish them from hard-wired machines which did one thing only. Meanwhile the arguments go on.

All in all, and in spite of the arguments, Turtle Tracks is an excellent package. It retails for $39.95 and is highly recommended. ■

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Courseware Cross-Section

Tree of Life

Reviewed by Evan McHugh

TREE of life is a program designed to teach the classification system used to define animals, and the way in which this system is based on the relationships between animals. It shows why such classification is needed, gives its historical background and describes the sequence of events that led to a modern classification and a five-kingdom system. The program is described as suitable for use by students in Years 5 to 10.

Tree of Life uses a tutorial style, interspersing instruction with interactive questions to check the student has understood. To stimulate interest there are many extremely well presented digitised pictures of animals. Diagrams are also used to illustrate and clarify the text.

Reinforcement

The quizzes are multiple choice, and, I feel, follow too closely what has just been read; with the material so fresh in students' minds answering the questions wouldn't require much thought. In some cases, however, the student is required to work things out or use deductive reasoning based on the information he has just been given. In these areas the program is more useful and challenging.

The program also paces the lessons. If students answer all questions correctly the first time, they can continue to the next lesson. If some answers are incorrect, or if the user seems to have difficulty with them, revision and a more thorough explanation are provided. In this way the program makes sure a lesson is understood before continuing.

As seems to be the case with all Educational Activities' (the publishers) software, the documentation for Tree of Life is very thorough. The programs themselves are self-explanatory, so the student can just sit down at the computer and start learning. Suggestions on how a program can be made more effective in the classroom are also given.

Additional Features

The usual time taken to complete the program is about 20 minutes. This will vary if students access the Classification Bank and the Dichotomous Key – extra sections of the program which give further study and research material.

Overall, the program is well put together and fun to use. The concepts are carefully explained so it is difficult to get confused. The use of quizzes keeps boredom to a minimum, since the user has to stay alert to answer the questions. There is also a help feature which allows you to call up explanations of biological terms by pressing the space bar. Any term on the screen can be thus explained, and you can return to your place when ready.

Tree of Life is published by Educational Activities and marketed in Australia by Micro Nationwide, 13/9 Bungan Street, Mona Vale 2103, PO Box 653; phone (02) 99 1772. In Brisbane the contact address is PO Box 48, Darra 4076; or phone (07) 376 6971. □

Chemistry — Redox Reaction

Reviewed by Bev Haigh

THE last few months have brought me many disappointments in my search for good science software. Recently, however, I found a very interesting and thoroughly professional package from ICITACS Educational Services. ICITACS is a department of ICI Australia, and has produced a series of specially designed experiments in chemistry, physics and biology, controlled and monitored by microcomputers. The package consists of a card which slots into the Apple IIe, software to run and monitor the experiment, and an instruction manual. ICITACS will shortly be extending the range to run on other common micro computers.

The package I reviewed was 'Chemistry – Redox Reactions'. This experiment features the theoretical and practical aspects of redox chemistry. The introductory section, which can be bypassed if you wish, is in two parts. There is a quick rundown on keyboard skills for the totally uninitiated, and then a section outlining the theory of redox reactions.

The experiment itself guides the user through the setting up of half-cells, and then monitors the reaction showing the location of the oxidation and reduction reactions, the direction of electron flow and the potential difference between the half-cells. Users are asked to enter answers to questions as they proceed, and are redirected to the theory if they make a mistake. All the necessary apparatus required to perform the experiment is supplied, except for equipment commonly found in school laboratories and the chemicals themselves.

Micro-Stimulation

The experiments have been designed to stimulate students to learn scientific principles with the help of microcomputers, and to develop an appreciation of the importance of microcomputers as powerful tools for controlling and monitoring real events. The package reflects changes occurring in the workplace, and acquaints students with new technologies likely to affect their futures.

The manual which comes with the package is written with the view that many science teachers may not be familiar with computers. The instructions and diagrams for installing the card are clear and precise. In my opinion there could be more detailed instructions for the preparation of the necessary half-cells, but I suspect ICITACS felt science teachers would not need this.

Queensland schools are not supplied with any tin compounds, so perhaps a method of making a 0.1M solution of Tin Chloride from tin metal and Hydrochloric Acid (which is how I made the solution) could be given.

There was also one annoying aspect to Redox Reactions: a bell sound is used to draw the user's attention to important points, and I found the frequency of the bell rather off-putting.

The cost of the package was a very reasonable $195. For the moment each experiment has its own card. I have suggested to ICITACS to combine the cards, at least within some groups of experiments, so the cost of individual packages may be reduced. If this can be done I feel most schools should make every effort to have at least one of the groups. For the time being, I recommend that science teachers investigate what packages ICITACS has because they are definitely the best science software packages I have seen. □

One World Countries Database

Reviewed by Evan McHugh

MANY common computing tools, like graphics packages and databases, are now being used in computer-aided instruction. The One World Countries Database is an information tool which applies all the features of a relational database to storing and sorting the socio-economic details of any number of countries.

The most significant

capability of a relational database is that which allows you to search through information files looking for data with things in common. For example, you could search through a database of school children to find which ten-year-olds have red hair. To do this you would keep details of each child, including age and hair colour, and your search would be based on the information in these fields.

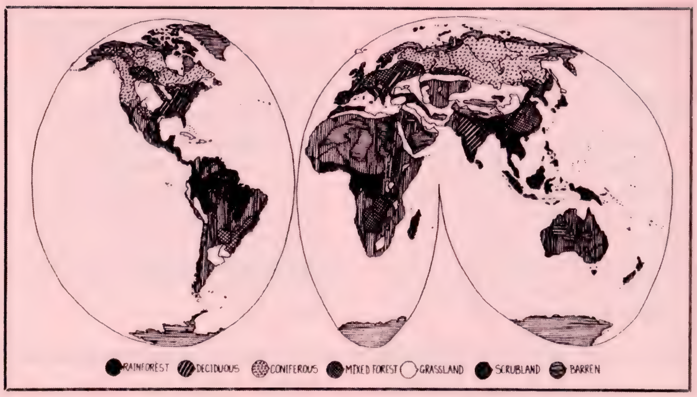
One World – Many Fields

The One World Countries Database has a data record for every country in the world. When the database was set up there were 178 countries. Each data record is divided into a number of fields, which include the country's region, population, neighbouring countries, exports, religions, leader's name, type of government and so on, for a total of 33 fields.

Each country is allocated a number, to make calling up records easier. Students can also initiate a search and go through a menu-driven criterion selection routine to find countries with, say, a liberal government in the European region. Such a search will generate the numbers of the countries which meet the criteria and the student can specify which of these countries he or she would like to see the complete details for.

The package more or less drives itself. It is not difficult to work out how things are done, so minimal training is needed to begin work.

Documentation for the One World Countries Database is quite comprehensive. A large quarto-sized binder covers every aspect of the package, describing its layout, the data that can be retrieved and the ways in which it can be retrieved. A large amount of material is also provided for teachers, telling them how to use the package to its fullest.



The Facts Can Change

Because the state of the world is always changing Active Learning Systems provides updates to the facts contained in One World, which the user can key in.

I think One World has tremendous potential for stimulating children to learn about the way the world can be broken up into numerous relationships and groupings. Imagination and teaching style will probably be the final deciders with this package which is well conceived and well executed.

More From Active Learning

Active Learning Systems recently released two other database-type packages. The first of these, 'Australia – A Profile', contains census information such as population, age distribution, ethnic origin, income, housing, employment, and industrial and agricultural

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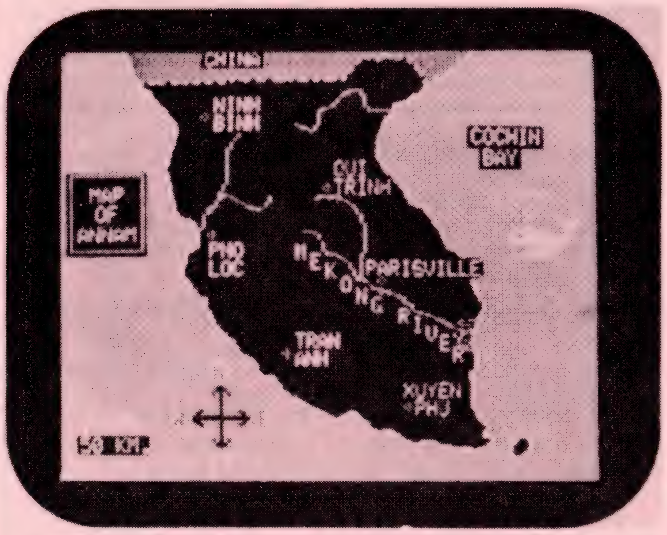
activity. It is designed to encourage students to learn to use computers – to analyse information and draw conclusions.

'Hometown' is a companion package to 'Australia – A Profile'. A kit designed for use in the study of local communities, it uses the computer to collate and analyse data gathered by the students. Its aims are described as, "to combine the development of practical skills with an appreciation of the 'character' of the local community and the needs of the people who live there." Active Learning Systems' products are distributed by Imagineering, 579 Harris Street, Ultimo 2007; phone (02) 212 1411. All three programs retail for $129. □



Annam

Reviewed by Evan McHugh

ANNAM is a simulation game based on a political situation similar to that which Vietnam found itself in before it fell to the communists. It is recommended for use in Social Studies courses, and claims to improve skills in understanding cause and effect, trade-offs involved in political decision making, US aid from the perspective of a recipient country, and the problems of a Third World Country. It also professes to stimulate interest in world affairs and encourage careful reading and analysis of information.

Apart from its claims as an educational tool Annam is a lot of fun to play. The program puts you in the shoes of the emperor of Annam, a country with an unstable government and which is threatened with overthrow by the armies of the communist forces. Your success as emperor is measured in terms of your popularity rating among the peasants, and the number of soldiers in your army compared to those in the communist army. To win the game you have to stay in power for four years, keeping your popularity over ten per cent and your army over 50 per cent of the size of the communist.

A Risky Business

You start off with a popularity rating of 60 per cent and the armed forces are even. Apart from nurturing your popularity and guarding against communist overthrow, you have to contend with Buddhist unrest, traitorous generals and wily old women with knives. For example, in one case, the Buddhists become restless and newspaper articles appear accusing you of being unsympathetic. You are offered the choice of ignoring the Buddhists, arresting them, or appointing one of them as your Minister for Finance. If you ignore them the Buddhists set fire to themselves and your popularity falls by as much as ten per cent. If you arrest them the same thing can happen. If you make one your Minister for Finance your popularity goes up, but the guy you appoint is a long-time rival and will try to do you in every chance he gets. He may end up doing nothing, but he might accuse you of stealing five million dollars – and overthrow you.

The choices go on like this throughout the game. Usually, if you make good choices you will do well, but sometimes, even when you are playing well, a disaster will befall you and you will be killed or exiled by events totally beyond your control.

Some of the options given are also restrictive at times. For example, you have no choice about the Americans. At one stage you are asked how many Americans you want to come and help you fight the communists. This is a move that will always cost you in the popularity stakes, but you cannot say "Yankee go home". The least you can do is ask for 5000 of their troops.

Another random choice is the old woman. An old woman approaches you and is threatened by a bodyguard. Your choices are to stop the bodyguard or let him blow her away. If you stop the bodyguard you are either a hero because the woman was asking for help for her starving family, or you collapse in a pool of blood because the treacherous old hag whips out a knife and slashes you to shreds. If you let the bodyguard blow her away you could be accused of brutality, whereupon your popularity falls by ten per cent; or if she is found with a knife, then everyone is relieved that you are safe and your popularity is increased. This particular scene does not teach much about making choices, as there is a 50-50 chance that the woman is armed. All you can do is guess, and hope you make the right decision.

Life Wasn't Meant to be Easy

It is rare for a player to complete the game successfully; there are so many ways for you to go under, often because of what amounts to bad luck.

In fact, my main criticism of the program is that in the end it's usually luck which determines whether you get a high score or a low one. The particular clincher in this luck game is how many troops you lose in a series of three battles you're more or less obliged to fight – get routed here (which is out of your control), and there's no way you can get a high score.

As well as this, I felt Annam could have gone so much further than it does; there were so many openings for all sorts of other events, misadventures and choices that it could have provided a real in-depth analysis of the continual trade-offs politics involves. It was frustrating that the game was always curtailed while it was still interesting and you were all set to try out more choices; the result was a certain feeling of superficiality. So now I'm waiting for someone to write 'Advanced Annam'; I'll be one of the first to use it.

Annam is very easy to get going on. One game and you'll have the feel. The program is self-explanatory and helpful in telling the user exactly how to do everything. The documentation is excellent, not only describing the way the game plays, but also giving a number of suggestions as to how it could be incorporated in classroom work.

The best way of playing Annam is to run through a number of games and try different approaches. For example, you can try being heavy-handed, build up a big army and hang the popularity. You can shoot anyone who even looks like a threat. Each game takes from five to fifteen minutes, so it's easy to complete several games in quite a short period of time.

Annam is published by Educational Activities. It is available in Australia from Micro Nationwide for $59. Micro Nationwide is at 13/9 Bungan Street, Mona Vale 2103, PO Box 653 and phone (02) 99 1772. The company's Queensland address is PO Box 48, Darra 4076; or phone (07) 376 6971. □

Library and Media Skills

Reviewed by
Evan McHugh

LIBRARY and Media Skills is a package designed to teach the basics of research, using library catalogues and a number of other reference sources such as card catalogues, title pages, tables of contents, dictionaries, atlases, encyclopedias, a thesaurus, newspapers, a book of quotations, and biographical and geographical dictionaries.

Despite what the average librarian will say, cataloguing and researching are boring skills. They are necessary and useful, but their value is only as means to an end and they are not interesting in themselves. Once learned they will be used to find your way to things that are interesting. The hump to overcome is learning and developing these researching skills. The average kid is probably more bored by these activities than anything else. To plunk a catalogue card in front of them and say, 'Here, learn about this' is probably the best way to get them thinking about their favourite rock band. So this package has a big job ahead of it right from the start.

No Boggling Boredom

To its credit, Library and Media Skills does the job without making it mind bogglingly boring. Having already developed all the research skills a journalist would ever need to use, I didn't find it hard to go over the same ground again. In fact, it was refreshing to look at study tools we use every day.

The program operates as a tutorial, giving short bursts of instruction followed by quizzes to check comprehension. The quizzes are well structured and keep your attention on the subject matter, because you have to get everything clear in your head before you can succeed in them. If the user doesn't get it all together the first time, that's okay because the program will pick up on mistakes and review the material at a much slower and more careful pace.

The average student will take between ten and 30 minutes to complete the program. According to the documentation, the best way to use the package is by grouping students of similar ability around the same computer, so they can all learn at the same pace.

The program's onscreen instruction is of very high quality. As with other Educational Activities programs, Library and Media Skills explains itself as the student uses it. During instruction there is no need to refer to any other material, so attention is not distracted from the job at hand.

The written documentation accompanying the program runs to 16 pages, and explains all aspects of the package and its use. It also gives suggestions on how the package can be used to supplement other course material.

The program also keeps the students' scores for checking by a teacher, and there is a bibliography of other materials which can be used with the program.

Library and Media Skills costs $59 and is published by Educational Activities whose Australian distributor is Micro Nationwide (13/9 Bungan Street, Mona Vale 2103, PO Box 653, phone (02) 99 1772; or PO Box 48, Darra 4076, phone (07) 376 6971). □

I'm an Expert

Reviewed by
Dr Robin Porter
Lecturer in
Teacher Education,
Macquarie University

AS its names implies, this program allows the user to be the expert and teach the computer about topics of interest to him or her. In the process of working through 'I'm an Expert', children are said to develop logic and classification skills. The program is designed for independent use by children from 12 years of age, while younger children may need help from an adult or older children.

I had help from two sixteen-year-olds in evaluating I'm an Expert, and they described it as "just great". Disappointed grumbles ensued when they were not permitted to enter the file they had created (absolutely fantastic, mind you) onto the review disk. In fact, this program actually displaced 'Jumpman' in amount of time spent on it over the weekend.

What is the draw-card then for a program that is not a game? There is no competition, no scoring, no 'excitement' of a battle, yet these two boys were prepared to spend several hours working at it. One of the answers lies in the fact that, for once, the 'expert' really is the user. The computer does not respond in a way that makes the user feel like an incompetent. Children are made to feel in control, especially when the computer responds with something like "I can't work out what it is", or "I got it – I've been taught well!" Another reason for its appeal is that users have a choice of working from a file in the computer, or of 'teaching' the computer and making their own file based on their own particular interests.

The introductory notes to I'm an Expert describe it as an educational program, but it's probably geared more to home use than school use since the accompanying notes are directed to the child rather than the teacher. Nevertheless, it could be a useful tool in the classroom, particularly for the social science, science, or even primary school teacher.

Forming and Developing Concepts

The claim that the program will help develop important logic and classification skills is certainly likely to be borne out. I'm an Expert should also be an aid in concept formation and concept development. Furthermore, skills such as identifying, labelling, and categorising are required when files are being created. Thus the program develops skills appropriate to

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the inquiry approach to learning, which is advocated by many curricula currently in use in both secondary and primary schools. For this reason it would fit very well into school programs, providing a means of both revision and recording.

The instructions to the user, both in the program and in the accompanying notes, are simple and clear; if they are read through carefully no problems should occur. There is one trap, which, although carefully explained in the notes, is only partially explained throughout the program when 'reminders' are given. The user is instructed to use 'A' or 'AN' before typing in words; for example, A Rabbit and AN Elephant. If the name you are thinking of entering does not need A or AN before it, you must type an equals sign (=); for example = Football, = The Pacific Ocean. It is most important to remember this, since it is very easy to simply type in the word or start with 'the' and end up wondering why nothing happens.

How It Works

Briefly, if using the data files from disk, the user 'helps' the computer to guess an item related to a selected topic that the user is thinking of. This is done by answering a series of yes/no questions. Alternatively, if the user is creating a new file about his or her own interest or hobby, the user teaches the computer about the topic by entering appropriate yes/no questions.

So, if you wanted to 'teach' the computer to tell the difference between your favourite animals, for example, you would:

- Type in 'An animal' at the prompt to type in a topic – the computer would then ask you to "Think of two things from that topic and enter a yes/no question that tells them apart."
- If the animals were a lion and a mouse, you might make the question 'Is it a fierce African animal?'
- The program would then require you to "Type in something from that topic that would give a yes answer to the question" – to which you would respond 'A lion'.
- Then you would be asked to "Type in something from that topic that would give a no answer to the question" – which you would make 'A mouse'.

And so on.

The program regularly displays a menu which asks users if they would like to continue with the same topic, start a new topic, load a new file from the disk or quit – so the user feels in control at all times.

Although it is recommended for children older than 12 to use independently, many primary school children should be able to master I'm an Expert. Under teacher or parent guidance and direction, children from Years 2 or 3 on should be able to use it with understanding and enjoyment. As the notes suggest that children younger than twelve may need help from an adult, it would have been helpful to have included some suggestions, particularly for parents, on how this help may be given; so that both interest and the satisfaction of initiating a topic may be maintained.

It is hard to say whether interest in the program would be maintained over time, or whether, after the novelty wore off, Jumpman and the like would take precedence again. It may be that adult direction would be necessary to encourage use in the long term.

All in all, I'm an Expert would appear to be a very worthwhile addition to your program library. It is available on diskette ($24.95) for the Commodore 64, and is published by Ozisoft, Suite 35, 8-24 Kippax Street, Surry Hills 2010; phone (02) 211 1266. ☐

Tic Tac Facts

Reviewed by Robin Porter
Lecturer in Teacher Education, Macquarie University

KIDS of all ages like a game of noughts and crosses, and it's noughts and crosses (or, more properly, Tic Tac Toe) that Tic Tac Facts is based on. There is one important difference that makes Tic Tac Facts somewhat less straightforward than noughts and crosses: in order for a player to place a nought or cross in the selected box, she/he must first answer correctly the maths fact that is in that box. If the answer is incorrect, the turn is forfeited and the other player has the advantage. The program is recommended for use by children aged eight to twelve.

The premise on which the program has been developed is that success in mathematics is dependent on instant recall of basic facts. This premise is questionable and misleading, since more important than instant recall of facts is an understanding of the concepts involved. Once such an understanding has been developed, then practice of basic number facts for instant recall may be warranted. Therefore, Tic Tac Facts should only be played by children who have developed an understanding of the facts through prior experiences with concrete materials in meaningful situations. The program would then serve its stated purpose of practicing maths facts for instant recall.

How to Play

Once players have decided who is 'noughts' and who is 'crosses', they can select from a menu the kind of facts they want to practice (addition, subtraction, multiplication, or a combination of all three). They then proceed to play the game in the normal way, with prompts from the computer as to whose turn it is.

On completion of each game the scores are shown (the winner gets two points), and another menu is displayed. From this menu players may choose to continue trying different questions, change players or end the game. If the players opt to try different questions they are presented with the first menu again, to select which operation they now wish to practise if they choose to change partners, they are returned to the beginning of the program and the names of the next players are entered.

The ability levels of the four operations seems to be quite varied. For example, the multiplication facts are more difficult than the subtraction and addition. The combination set therefore contains problems of varying difficulty. The addition and subtraction are very simple. It is possible that children younger than the suggested eight-year-olds would have little difficulty playing the game, if they selected only addition or subtraction. Older children who have a reasonable understanding of basic mathematics facts and can recall them will play the game from sheer enjoyment of playing noughts and crosses.

Presentation

The layout of the screen is clear and attractive, and the colours used are sharp and varied, thus providing interest and easy readability. Instructions given on the screen are very straightforward. Because the game is so simple to play, the documentation sheet contains little more than loading instructions for both cassette and disk.

This program is more suited to home use than to use in schools, since teachers would want to be able to individualise the content according to children's needs, or to gear the maths to what was being dealt with in the classroom situation. However, it should provide pleasure for family and friends at home, at the same time giving practice in basic maths facts for those who need it.

Tic Tac Facts is published by Ozisoft, Suite 35, 8-24 Kippax Street, Surry Hills 2010 (phone (02) 211 1266). It is designed for use on the Commodore 64. The disk version costs $24.95, the cassette $19.95.

Spell Out

Reviewed by
Dr Robin Porter
Lecturer in
Teacher Education,
Macquarie University

SPELL OUT is what might be called an ideal program. It is clear and simple, easy to use and requires the user to determine the words which need practising. Furthermore, the activities it uses are of the kind that children of all ages like doing. There is just one snag – and it's a big one, particularly for home users. The exercises can only be done from hard copy. This means that Spell Out is only useful if a printer is available. There is no way any of the exercises can be done on the computer. Once the words to be practised have been typed in, and the computer has done the sorting and sifting to produce the exercises using these words, and the hard copy has been produced – it's back to pencil and paper. Thus, the program would seem more appropriate for school use, as schools are more likely to have printers than are homes. In fact, it could prove very useful indeed for teachers.

According to the documentation, Spell Out is "designed for primary school children to help them study their weekly spelling lists". It certainly does this, using a variety of techniques. These include:

- typing the words incorrectly
- letter scramble
- fill-in the missing letters
- wordsearch

Whichever Words Want Work

The words need not be confined to the 'weekly list', but can be any list of words. For example, they could be all related to a particular topic or hobby that the user is interested in, or they could be words the student has particular difficulty with. In this way, the use of the program becomes more flexible and fits better the current approaches to teaching spelling, which are moving away from graded weekly lists to a more individualised approach of teaching words children want to use in their writing.

The solution to the wordsearch activity is given, so children can check for correctness. A check of the other activities would have to be made from the original word list.

The notes to parents are very brief indeed. While teachers who use the program will know how to encourage and guide children, and help them with corrections, it would probably be helpful to parents to have some suggestions on how they might support and encourage children, help them to correct their work, and complete the exercises without reference to the word list. That is, the value of the program would be lost if it became merely a copying exercise, or if spelling errors remained uncorrected.

Although there are instructions for loading from disk on the program packet, the documentation provided only gives instructions for loading from cassette. This could be changed to include instructions for disk, merely to reassure parents and teachers that they really do have the right notes for the program they purchased.

Spell Out should provide a very enjoyable means of practising spelling, both in the home and in the classroom. It requires plenty of user involvement; and the student determines what words are to be practised, thus also determining the level of complexity. Also, the user can proceed at his or her own pace. All these characteristics are consistent with sound learning practices. Investment in this program should net a good return – not only for primary school children, but for adolescents and adults, too.

Spell Out is published by Ozisoft, Suite 35, 8-24 Kippax Street, Surry Hills 2010 (phone (02) 211 1266). It costs $19.95 on cassette and $24.95 on disk. □

Concentration

Reviewed by
Robin Porter
Lecturer in
Teacher Education,
Macquarie University

AS the name implies, Concentration requires a good deal of concentration and attention, and a good memory. It is an adaptation of the well-known card game, to use with the computer.

In case your children have not yet introduced you to this game, or your memory of your own childhood games is hazy, here's a brief description.

A box on the screen contains 45 coloured squares arranged in five rows of nine. Each row is a different colour and each square is numbered in counting order from one to 45. Underneath the coloured squares are little pictures. The aim is to uncover matching pictures. Thus, the players must remember where the pictures are, so when it is their turn they can uncover the pictures which match. The player who matches the most pictures is the winner.

Moving Pictures

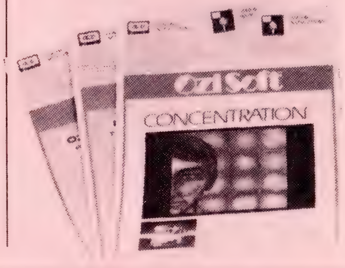
The computer does not really do much more than the card game, except that it helps to focus attention when the pictures are uncovered by having them move – thus taking advantage of the computer's graphics capabilities. For example, little men jump up and down, scissors open and close, and crocodiles snap their jaws. A further difference is that the computer keeps score. It also prompts with a statement at the bottom of the screen: "It's your turn Sally".

A disadvantage of playing the board game version of Concentration is that after a few games it is possible to memorise the pattern of pictures, so players can score from knowing before the game starts what pictures lie under the numbers. The computer game has avoided the danger of the fixed 'board' by rearranging the pictures under the numbered squares each game. No doubt a finite number of arrangements has been programmed into the game, but there are probably sufficient variations to ensure many, many games before a player could recognise the pattern.

One of the strengths of the game is that it can be played by up to four players. Thus it allows for social interaction, and encourages sharing and co-operation. One person is not just pitted against the computer in isolation from the rest of the family, as is the case with some computer games. Concentration allows for discussion to take place, and hence, for younger players, provides a forum for language development. Like the card game, it can generate some happy, relaxing times together for the family.

Children enjoy playing Concentration, just as they enjoy card games, drafts, dominoes and Snakes and Ladders. Whether or not it warrants the greater expense of a computer game compared to the relatively inexpensive card game is a matter for debate. The computer game offers no important enhancements. However, if children have abandoned traditional board and card games in favour of the computer, Concentration would be a worthwhile purchase since it promotes an alternative set of values to the violence and destruction of many computer games.

Concentration is published by Ozisoft, Suite 35, 8-24 Kippax Street, Surry Hills 2010 (phone (02) 211 1266). It retails for $19.95 on cassette and $24.95 on disk. □



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Courseware Cross-Section

Senior School Science

Reviewed by Mike Newnham

SENIOR School Science is a program set of six cassettes, containing ten programs. The tapes are packaged in a wallet-style vinyl case with a moulded nest for each cassette.

While I am not a teacher and could not test these programs in the field, I have assessed each program on the basis of how it treats its subject, and on the extent to which an attempt is made to provide the student with some feedback on his progress. Some material does not lend itself readily to being incorporated into a computer-aided instruction program. For instance, large amounts of text are more easily read from a book than from a VDU. However, computer simulations of events or systems which students would ordinarily be unable to see will extend their understanding of a process by allowing them to 'observe' them.

Some of the following programs provide primitive but demonstrative simulations, together with an evaluation of the system they are designed to represent. Of the remainder, some are simply quizz-style programs aimed at testing and reinforcing a student's knowledge of his subject.

The six tape titles are:

- Introduction to Chemistry
- Chemical Equations
- Coulomb's Law
- Kepler's Laws
- Millikan's Experiment
- Vector Tutorial

Introduction to Chemistry

On Side One this tape has a program entitled 'Compounds and Formulae', on Side Two is 'Elements and Symbols' which should in fact be mastered before 'progressing' to Side One.

Using Elements and Symbols, pupils may select whether the computer will prompt them with either the name of an element or its chemical symbol. Students must respond to the prompts with their counterparts (either element or symbol). This program works quite effectively, with letters created from low-resolution, enlarged graphic characters which are very easily read from the back of a classroom.

Correct spelling of element names is necessary, and entry of the elemental symbols must be in conventional form. For instance, a two-letter symbol such as Br (bromine) must be entered with the first letter in upper case and the second in lower case.

Tests are presented in groups of ten questions, with a choice of Years 8, 9 and 10 as separate levels, and Years 11 and 12 selected as one level. The tests simply include more of the periodic table the higher you go in Years. The program uses the elements up to and including thorium.

'Compounds and Formulae' operates in much the same way as 'Elements', except the student must supply a complete chemical formula in response to being prompted with the name of a compound.

There are 110 basic inorganic compounds used in this program, together with their chemical formulae. An interesting feature is that the correct subscript format is used when formulae are printed to the screen. The author has simply created his subscript characters using high-resolution PCG characters. This detail, while obviously necessary, is still a nice touch.

Tests on Compounds and Formulae are presented in groups of five questions, and the student is given a score on completing each group. Students using this program will need to have an understanding of compound fundamentals and chemical valence.

Coulomb's Law

In 1785, Charles Coulomb used a device called a 'torsion balance' to observe and measure the forces of electrical attraction and repulsion between charged spheres. From these experiments he deduced the physical law to which these forces adhere.

This program simulates an apparatus (not the torsion balance) which allows students to demonstrate the behaviour of these forces, and to observe some of the basic relationships for themselves. The equipment used for the experiment is created as high-resolution graphic line drawings on the screen.

The student may charge one of two spheres and carry out some tests to examine the nature of the forces existing between the spheres when they are brought near to each other. The program does not prove Coulomb's law, but demonstrates the process by which it was derived by Coulomb.

In the main, this program is above average, but it is somewhat vague in the instructions to the student regarding the use of the simulated apparatus. Providing a teacher is present to monitor the use of the program, this may not be a problem.

Kepler's Laws

Kepler's Laws is a program which uses basic animation techniques to model planetary orbits, and is based on Johannes Kepler's three laws of planetary motion.

The aim of the program is to demonstrate to the student the application of these laws. The program first tests the Law of Periods, which applies to the period of a planetary orbit. An imaginary solar system with three orbiting planets is simulated on the screen. It is necessary to boost the brightness of your monitor here, to make the planets (single pixels) stand out from the stars (also single pixels), although the planets are moving.

Students examine the relationship between the radius and the period of a planet's orbit using this law, and are asked to make certain calculations and enter the results into the program. An error on their part will not cause students to be ejected from the program with a zero score, but will instead generate a request for the them to re-enter their results. On completion of this stage, the program instructs the user on how to best evaluate the results he or she has obtained from the calculations.

The second part of this program is designed to demonstrate both the Law of Areas and the Law of Ellipses, by jumping to another fictitious planetary system where a lone planet orbits a star. The orbit of this planet is halted at regular intervals, to allow students to retrieve data for use in their own evaluation of these two laws.

This program is introduced by a line drawing of a well-known time machine and its equally well-known occupant, both of whom might have been better off somewhere else in time. The graphics used to create the two imaginary systems could stand improvement in the form of highlighting the orbiting planets, or making them larger than the stars.

Aside from the use of simple animation, I don't believe this program provides an any more revealing study of Kepler's Laws than a good physics text book would.

Millikan's Experiment

Side Two of this tape provides an introduction to the Millikan oil drop experiment and details the underlying principles. There is a discussion of the behaviour of charged particles within an electric field, and of the way Millikan was able to use these principles in his test apparatus to deduce the electrical charge on one electron.

Students are tested a number of times during this introduction, to gauge their understanding. The tests are in the form of fundamental questions which, if answered incorrectly, cause the machine to respond with both the correct answer and a suggestion that the teacher's help be sought.

Side Two of the tape is the actual simulation of Millikan's experiment, and the program opens with an explanation of the equation used to derive the charge on a body in an electric field. Following this is a detailed examination of the Millikan experiment, commencing with the apparatus and an explanation of the function of each item.

By means of a real-time graphic display the student may simulate the experiment himself, retaining complete control over all the variables.

This is the most demonstrative and informative tape of the set. There has certainly been a great deal of effort put into the two Millikan programs to provide an excellent discussion and simulation of the experiment. In the absence of the proper apparatus for this experiment, the use of computer simulation is far superior to using a text book alone.

If you have access to a Microbee, and if Millikan's Oil Drop Experiment is on your syllabus, then this program is well worth investigating.

Vector Tutorial

Vector Tutorial (Side Two) opens with a discussion of the nature of vector and scalar quantities. The program proceeds through the geometric method of addition of vectors in a clear and concise manner.

Students using this program are tested at the end of each stage by means of sets of five questions. Failure to answer all five questions correctly prevents the student from progressing further, until he correctly answers five more questions.

This tutorial is very well put together and I believe, from my own experience of the program, that it makes a dry subject just a bit more palatable.

Side One of the tape is titled 'I-J Vectors' and is an examination of the resolution and addition of vectors, using the analytic method. This technique is applied where vector components may exist in more than two dimensions. Again, this is a well written tutorial which tries to ensure, at every stage, that the student is following the subject. The program also provides a five-question test, to enable students to see just how they are coping.

The Vector Tutorial tape provides solid, valuable information on its subject. If vectors are on your syllabus, or if you just want to see a fine presentation, I recommend this tape.

Now, The Bad Points

Well, there you have it: a science software six-pack from Honeysoft. It is time, now, for some criticism. I can't help wondering if even the creators of the Microbee have little faith in the 1200 baud tape routines of the Bee, since all ten programs in this package were dumped at 300 baud. There's nary a 1200 baud copy to be found. The total loading time for all these program runs to about 50 minutes plus. This is not a serious drawback, because the programs are not copy protected and it's possible to create a 1200 baud back-up copy of each.

One thing I have mentioned in the past and will continue to gripe about, is the presence of spelling errors in programs. There is absolutely no excuse for them. Three of the programs in this package contain spelling errors, though no important terms are spelt incorrectly. While the original fault lies with the author of the software, the distributors of the material compound the error by selling the program with errors intact. Spelling errors in educational software are particularly intolerable.

Gripes aside, this package is reasonable value for money, but see if you can get a 1200 baud copy as well. The two finest programs in this package are Millikan and Vector Tutorial, which represent truly professional efforts.

Senior School Science costs $49.95 on cassette and is produced by Honeysoft, a division of Applied Technology at 1a Pattison Avenue, Waitara 2077; phone (02) 487 2711. ☐

Geograbee

Reviewed by Mike Newnham

IF YOU believe you know the countries of the world really well, here's a program which will test that belief. Geograbee is an exhaustive program which poses a total of 140 questions in a beat-the-clock race to score top points. While it has obvious benefits as an educational program, it doesn't make a bad game either – a refreshing change for when those other games begin to pall.

Intended for use on the Colour Bee, Geograbee creates some very good maps. In the interests of program size and loading time, fine coastal detail has been replaced by straight lines. This does not detract from the legibility of the maps.

The program operates by mapping part of the world onto the screen, with certain areas numbered. The user must then respond to the question "Which number is ...?" by pressing one of the digit keys to indicate his or her choice. Four points are awarded for a correct answer, one point is lost if you're wrong. Also, if the answer is incorrect, the correct location is highlighted by a flashing red character.

The program begins with Australia and some of its Pacific neighbours, moves on to the world's oceans, and thence to the other countries of the world. It's not easy to score the maximum 560 points in the 150-unit time limit.

The program is worth its price. But, while the graphics are very well done, there are spelling errors in the names of two countries: Quatar appears as Qater, and Malaysia appears as Malasia. Misinformation is unforgivable in educational software.

I found the program quite enjoyable, though it is not something one could play for hours on end. I would recommend Geograbee as an educational device, but not before the two errors are removed.

Side One contains only a 300 baud dump of the program, however Side Two of the tape carries two 1200 baud dumps.

Geograbee costs $12.50 and is available on cassette only from Applied Technology, 1a Pattison Avenue, Waitara 2077; phone (02) 487 3798. ☐

Courseware Cross-Section

Extended Turtle

Reviewed by Mike Newnham

SOONER or later, the majority of children will find themselves confronted by a computer keyboard. While computer games are generally entertaining, they have little value as a true educational medium. Programs which are designed to educate as well as entertain go a lot further towards helping the child learn, but there is a potential trap for young players, so to speak. The child's thought and response patterns can fall directly under the control of the programmer.

This may occur where the child has little latitude in his or her interaction with the program. Absolutes such as 'you are right' and 'you are wrong' tell the child only that. Children need room to experiment and test their ideas.

Logo Beginnings

This has all been said before, by people with degrees and diplomas, but much of it is common sense. Some of those who were aware of the child's need to be in control of the learning situation evolved a program called Logo. Logo introduces children to the computer by providing them with an outlet for their inquisitiveness, while at the same time demonstrating the nature of the computer and its precise requirements as far as programming is involved.

Logo was developed by Seymour Papert, of the Massachusetts Institute of Technology, and contains a set of procedures grouped under the name Turtle Geometry. Logo Turtle often makes use of a real robot turtle which has a pen poking through its middle. When this turtle moves around a large sheet of paper on the floor, the pen leaves lines to show where the turtle has been. Using simple commands children can program the turtle to draw shapes and pictures. This type of turtle has been used successfully with pre-school children.

Stretched Aquatic Reptiles?

Extended Turtle was developed by Chris Welsh, a teacher at Denistone East Primary School, from a program written as part of his Diploma in Education at the University of New England.

Extended Turtle is not a direct implementation of Logo, but it does use the underlying concepts of Turtle Geometry, in the form of Turtle Graphics. To quote directly from the Extended Turtle handbook: "Turtle is based on the philosophy that in a short introduction to computer programming the following concepts are of prime importance:

- That a computer program is a list of instructions which are stored in a computer.
- That the program is written in a special language, the rules of which must be followed exactly.
- That the computer will follow a set of instructions exactly, even if the result is not what was intended.
- That the program is often wrong (has bugs) initially and has to be corrected or 'debugged'.
- That a program may be written so parts of it are automatically repeated a required number of times.
- That a program can be used as a unit within another program.
- That a program may be stored temporarily (in a computer's memory) or permanently (on a tape or disk).
- And that none of these concepts can be properly appreciated unless all pupils have as much opportunity as possible to try things out for themselves on a real computer."

What the Teachers Say

Does Extended Turtle bear out this philosophy? It has been in use now for some time, in a number of schools with Microbee computers, so I sought the opinions and observations of a few teachers who have been working with it.

Rod Ralston, a primary teacher at St Anthony's Clovelly, provided the following observations:

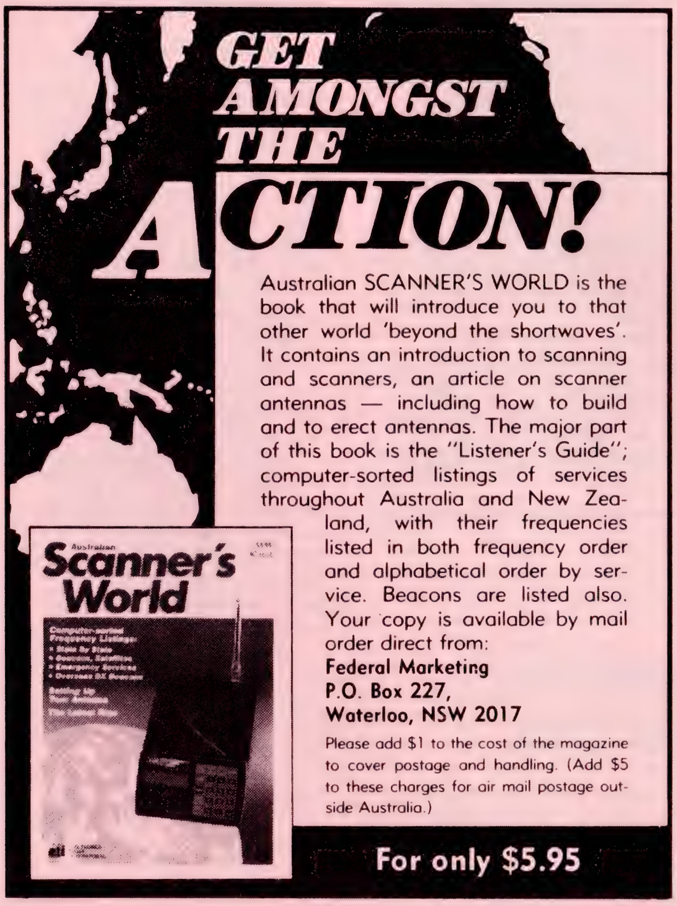
"Problem solving, and its inherent skills of investigation, and hypothesis testing and evaluation – which leads to further hypothesis until a satisfactory solution has been reached – is recognised as one of the most useful teaching/learning strategies for students and educators alike.

"Thus any child using Turtle to form, revise and edit a 'procedure' is using the above skills and enhancing the mental characteristics necessary for 'problem solving'."

Rod also believes Extended Turtle does bear out the philosophy behind it, and summarises his evaluation by saying, "Turtle is more than just a fun thing. It is a program that has educational relevance and significance, at an affordable price, on affordable hardware. It involves children in analysis of situations so they develop strategies to solve problems. This is applied to all the computer activities of programming, revising and debugging, at a level children can understand, and at which they can achieve results. It also involves them in spatial investigation and discoveries that relate directly to many curricular aims, specifically those that are maths related.

"In conclusion, it is a program that is fun, useful, relevant and educational all at once and, thus, is worthy of notice both from parents and educators looking for software for their children's or school's Microbee."

I sought some other educators' comments on Extended Turtle. Howard Gould, a maths teacher at Penrith High School, has used Turtle with children in Years 7, 9 and 11, as well



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as with primary and secondary teachers. His comments are in much the same vein as Rod Ralston's, with these additional observations:

"The availability of variables, loop steps, sound and colour (if you have a colour Bee) allow older and/or more experienced/talented users to remain interested and be challenged. The problem-solving situations can be quite complex and advance very quickly without the user first being required to learn a great deal of syntax, vocabulary and so on."

Beverly Avery, also a maths teacher at Penrith High, has found Turtle to be of value in the areas discussed previously, and adds, "This year I introduced Turtle to a Year 11 computer studies group of average ability before introducing BASIC. Using Turtle, the group was able to grasp the logical use of commands faster than by using BASIC. The students were able to experiment during the first lesson, and learnt very quickly that you must instruct the turtle to do everything: that is, if a command is left out, the program goes wrong."

One observation made by some teachers is that while Turtle is an ideal program for children from eight years old on, it has limited applications with senior students. BASIC is better for extending older students' knowledge, and it allows them to approach problems that are not of a graphic nature.

Technical Observations

Extended Turtle does not implement 'IF...THEN' or case statements, and does not permit true recursion as in Logo. However, the concept of recursion can be demonstrated to quite a reasonable extent by the specification of a counter to repeat a procedure a number of times.

Extended Turtle is available on both disk and tape. The disk version supports an X-Y plotter, which overcomes the programmable character generation limitations of the Microbee. A screen dump to a dot matrix printer is possible with both disk and tape versions, so students can have a hard copy of their work. The Extended Turtle manual is excellent: it is well presented, clearly written and quite easy to follow.

Based on my own experimentation with the program and on the comments supplied by the teachers, I believe Extended Turtle is well worth purchasing, especially if you wish to introduce the fundamentals of computer programming to children who have no previous programming experience.

The cost of Extended Turtle to schools (tax exempt) is $30. This includes either one disk and the manual or two tape copies and the manual. To the general public, the cost is $28 for one tape copy and manual, or $33 for a disk and manual.

Extended Turtle is available from Nectar Software, 1 Barracks Street, Emu Plains 2750. ☐

Science

Reviewed by Professor Jonathon Anderson
Faculty of Education, Flinders University

SCIENCE is a package produced by Wesoft, the software arm of the Education Department of Western Australia, for children in the middle to upper primary school years. Included in the package are a disk containing two programs – Dirigible and Balloon – an owner's manual, six coloured maps, and a keyboard ruler.

The authors describe Dirigible as a program in which "students become the crew of a dirigible and must fly their craft over swamps and seas, around buildings, hills and tall trees, to land at the designated target. In doing so the students are interpreting maps, thinking about movement in three-dimensional space, using chief and intermediate compass points, recording and analysing information, using the idea of vector addition, and learning to co-operate with others."

It was enormous fun reviewing this package, and the students who helped me thought "it was great", too. Although the program Dirigible is part of a science package, it crosses subject boundaries. There is clearly mathematical thinking involved, as are map reading and navigation skills, simulated instrument reading, recording and analysis of data, interactive reading, decision-making – and all in the context of a challenging and enjoyable game.

This is a splendid example of the microcomputer being used in a way that no other material or equipment could match, short of actually piloting an airship – and even then working through this program might be recommended first. The high-quality colour maps, the teacher's and students' manuals, worksheets and computer program have obviously been carefully planned and produced by an expert team.

Students Must Co-operate

Dirigible will appeal to teachers who value co-operative activities. As in many real-life activities, playing this game successfully requires several hands; students need to record altitude, position, wind speed and direction, and various other data, before deciding on the next set of adjustments.

In the classroom, this program is likely to be most useful for its suggestions on classroom management. There are six dirigibles from which to choose and the program is so designed that each group of students spends but a short time at the keyboard. Their analysis of the information given and the discussion necessary for deciding what to do next takes place away from the microcomputer while another group is having its turn. One of the brilliant touches which makes this possible is the computer's capacity to remember where each group's dirigible is in relation to its target and, furthermore, its ability to retrieve all this information even after the microcomputer has been switched off.

Also on the disk is a program allowing users to set the volume level – not simply to 'on' or 'off', but to any desired level in between. Although purely functional, even this short program shows an association between volume and sound and the volume of liquid in the airship's tank, which serves as a teaching point.

Balloon Cartoon

The Balloon program is described by the authors as, "A simulation where students learn to associate the actions of a cartoon character with changes in a line graph." Designed for slightly younger students (from Years 4 to 6), it gives practice in interpreting graphs and in forming and testing hypotheses. The animated dog blowing up a balloon, together with the graph of size against time, is one useful way of introducing what is a relatively abstract topic. The facility to pause the action, thus allowing students to anticipate what will happen to the graph, is another nice feature.

The documentation for Balloon suggests both computer-based and non-computer activities. The sound of the balloon being inflated adds to the realism of the scene, and the screen presentation is well set out and easy to read.

In summary, this is a superb piece of software which would find application in primary schools everywhere. Dirigible especially must rate as one of the top educational simulations.

Science costs $40 and runs on the BBC Micro. It is available from The Systems Research Institute of Australia, 22 St Georges Terrace, Perth 6000. ☐

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The Plato Range

Reviewed by Dr John Barrett and Jon Barrett

What you first notice about Plato packages is the obvious care that has been put into presentation. All materials are in a solid plastic-coated 'book' which opens to reveal the disk(s) in a packet on one side and the operator's manual on the other.

The manuals cover almost all areas the learner or teacher will require. Although there are no listings or provisions for teacher-generated adjustments to the program, full documentation of objectives, concept application in the classroom and suggested additional activities are included.

The Plato material was initially only available for Control Data mainframes, but this has now been extended to microcomputers of different brands. With about 20 years of research and development behind the materials, we can expect some good products from the range.

Control Data Publishing also produces educational software from companies such as Krell, Cosine, Thoughtware and MECC, at its plant in Moorabbin, Victoria. The company publishes a quarterly catalogue of its products, which may be obtained by writing to Control Data Publishing, 493 St Kilda Road, Melbourne 3004 (phone (03) 268 9500).

This review looks at four of the many packages released by Control Data in Australia. Of these four, The Computer Keyboard retails for $69.95, and the others cost $49.95 each.

The Computer Keyboard

THIS package comes with two disks. Disk 1 is entitled 'Introduction to the computer keyboard', and the first problem we encountered with it was the old 'blank screen' dilemma. We tried switching on the printer, as some programs (particularly those written in Pascal) require this connection – but to no avail. The documentation supplied the answer: The Computer Keyboard is designed for use on computers with a 40-character per line screen. Our Apple has an 80-column card which would ordinarily have to be removed for the program to work. We found a way around this by operating out of the normal video port instead.

Finally the menus appeared on the screen, offering six alternatives: Welcome Introduction, Typing, Erasing, Typing Accurately, Characters and Summary. The Introduction option was a 'page turning' activity which listed where computers are used. The information was useful to a beginner, but had no graphics or demonstrations of computer capabilities.

One Size Fits All

Next came the Typing Tutorial. It didn't adjust to the Apple IIe – it just told us our keyboard was something similar to that shown on the screen. The display of keys and the associated directions were quite good. It was here that a slight error in logic became apparent: at this point we were shown how to use the return key, something a beginner would have to have known just to get this far. This is a typical example of good programming and absurd instructional design.

We then tried the Erasing option. (Of course, if you had made a mistake in the previous section you would have been in trouble.) We were shown how to make a correction using the Left Arrow key. The only problem is that in this Plato tutorial the cursor movement is 'destructive' (it wipes out text as it moves). In reality, this does not happen with BASIC programs on the Apple II+ or IIe. Practice exercises in this section encouraged accurate inputs through multiple choice questions, but only one activity involved typing practice.

The 'Characters' section emphasised that everything typed from the keyboard generates a computer character. It's a simple idea but an important concept that, for example, tapping the Space Bar does not result in a blank space of itself, but sends an ASCII character to tell the computer to leave a space.

The Summary section briefly reinforces what you've learnt.

Our conclusion was that while the program is of good design and is well-executed, it makes more sense to use the 'Apple Presents Apple' program which comes free with your computer, and is of an even higher standard.

The Keyboard for Graphics

Disk 2 is called 'Using the keyboard for computer graphics'. The general menu displays five options: an Introduction, Computer-Generated Design, Designing and Printing Stationary, Computer Graphics and Animation, and a Summary.

The first section introduces the idea of computer graphics and some of their uses. Then follows the Computer-Generated design section, which gives a good demonstration of repeated graphics patterns and lets you produce your own designs – an excellent exercise.

Next you design the border and headings of some fancy stationary, which you can experiment with and print out.

Computer Graphics explains areas of application and gives some very good demonstrations of animation, graphs and charts. Creating your own pie chart by nominating a title, colour and data provides an effective interactive exercise.

The second disk is instructionally sound and generates high interest through good graphics. However, you cannot 'look into' the programs themselves, and would only want to go through it once or twice.

Overall, the screen presentations of The Computer Keyboard were good, with clear text (but American spellings!) and precise instructions. If you could purchase Disk 2 separately this would be very worthwhile. As a total package we would have some reservations about buying The Computer Keyboard for a school, and would not recommend it for home purchase because you get most of what it offers with your Apple computers.

Physics

THE Plato Physics program is intended for senior high school students, to provide practice in analysing and evaluating a problem in elementary mechanics, and in identifying the information needed to arrive at a correct answer.

An animated example of a physics problem is presented and the student has to arrive at the correct answer through application of appropriate concepts and accurate calculation. The challenge is to use the least amount of 'help' to solve a problem. A game mode is employed in which 'help' information costs $5 a pop, Plato data cost $2, and your budget is $25. Nine separate exercises are presented, the first of which acts as an example problem at your request. The computer provides data about the situation (distance, time, mass and so on), formulae, help, and a calculator function.

The program is essentially a 'test' in application of such concepts as Newton's Laws of Motion and Gravity, and Laws of Conservation of Momentum, Energy and Kinetics. The exercises encourage analytical skills and information processing procedures.

Gripes and Praise

We had two criticisms of Plato's Physics: the program may drop into 'machine code' and bomb-out if you do something very wrong in the calculator mode, such as entering a calculation too big for the computer (overflow error); and the almighty dollar is again used to score – why not just have a simple point system?

There are more good points than bad:

- Problems are shown graphically.
- Help is available to explain the problem, or the user can go further through a help index which gives rules, key usage and explanations of how to use the calculator.
- Data retrieval is implemented by typing a request in common English. The input sentence is evaluated by the physics program and handled accordingly by identifying key words and returning the data. This aspect is very impressive.

Plato Physics is one of the best programs we've seen for some time. Keep in mind the objective of the course which is clearly stated: this is not an elementary tutorial for beginners, but presents problem-solving activities demanding intelligent application of previously learned facts and principles. The program is excellent and presents a model for other courseware to emulate. We can highly recommend the use of Plato Physics (Elementary Mechanics) for senior high school or tertiary introductory physics courses.

French-Vocabulary Builder

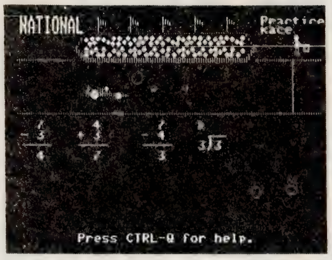
THIS program is intended to provide drill and practice in recognising and understanding a basic French language vocabulary. The objective is achieved with a database of 500 commonly used French words divided into ten categories. Drills are in three translation modes: English to French, French to English and a combination of the two.

Two exercise activities are offered: the familiar game of 'hangperson' (hangman?); and a pyramid game in which the student must correctly answer twelve multiple-choice definition questions to complete the pyramid. Both exercises use good graphics to provide visual stimulation.

The programs run very well and should help build a vocabulary of French words used in personal reference, dealing with numbers, travelling, eating, shopping, at school and in general use. The program could be used at school, in the library, or at home; individually or in groups.

Our only criticism is that the scoring system for the Pyramid Game is based on accumulating dollars for winning. Surely if a money-based scoring system were necessary at all, it would be of greater educational value to use Francs ...

The program does not pretend to teach conversational French (pronunciation, conjugation). Taken as it is intended, it may be recommended for individual drill and practice of basic French words.



Press CTRL-Q for help.

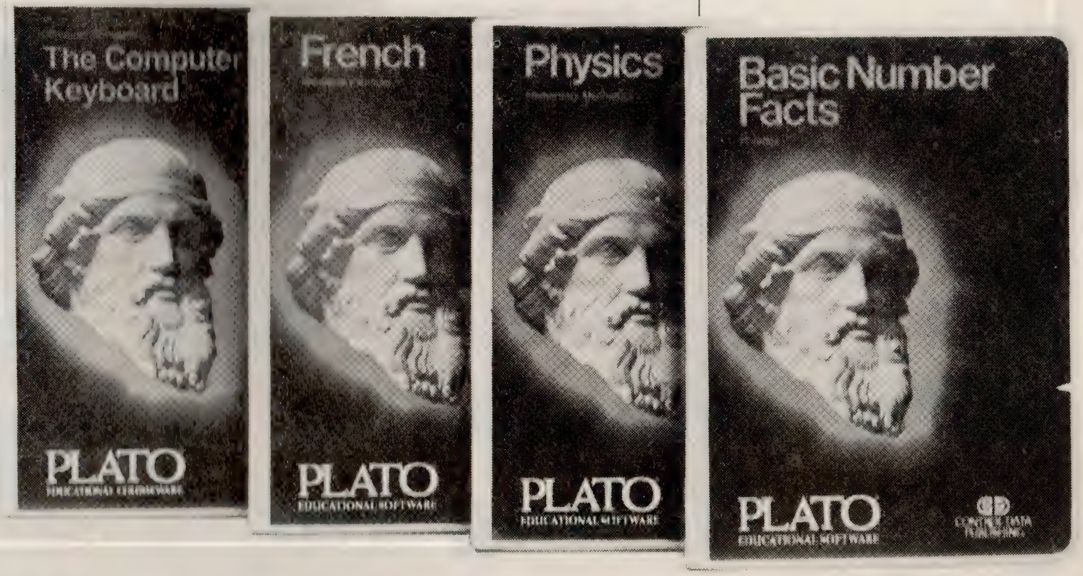
Basic number Facts — Practice

THE Basic Number Facts program is designed to improve speed and accuracy in the numeracy operations of addition, subtraction, multiplication and division. These objectives are achieved through a 'Racetrack Game' in which you compete against the computer.

There are four separate lessons on disk. Each lesson allows a maximum of ten races, and each race has ten problems to solve. The goal is to improve speed and accuracy with each race. When the problems are solved in less time than in the previous race, the student wins. If a mistake occurs the learner may make a correction or call for help. Making three mistakes on the same problem automatically initiates the help program, which then presents the problem graphically. For a test of speed and accuracy with whole numbers and basic operations this program is very good.

Another attribute of Basic Number Facts is that the user has control over sound, exiting and beginning again, as well as access to the 'Help' section – at most points in the program.

The accompanying booklet has some good descriptive materials explaining how the program may be used in the classroom, especially in regard to preparation and teaching strategies and follow-up activities. Student record keeping is suggested, but it would be nice to have this built into the package – one of the strengths of the original mainframe Plato Programs. All in all, this package can be recommended for introducing or reviewing addition, subtraction, division, and multiplication of whole numbers. ■



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THE Education Market

Hardware and software suppliers have sighted a pot of gold at the end of the computing rainbow – it's the education market. The available funding for 'computer education' seems limitless. Here Evan McHugh looks at where the money is coming from and how the major contenders are going about grabbing their share.

A blinding flash and deafening explosion herald the entry of Darth Vader. He strides about the giant IBM-PC, looking threatening – he's the centre point of the IBM education show. With Darth and his collection of friends, schoolchildren are learning the value of computers in everyday use and how to face them without fear.

From Darth Vader, who some might say nicely captures the IBM image, to the firmly entrenched Apple, computer hardware and software companies are realising the size and potential of the education market. Already, many depend on the education market for a considerable percentage of their sales. Others see education as the new growth area in computing, or simply as an area where their products can be of genuine benefit.

The Market

Sharon Ottery, education co-ordinator for software publisher McGraw-Hill, says, "There is a lot of pressure to get computers into schools; pressure from federal and state governments, and parents. They're saying 'This is the information age and we've got to keep up'."

Funding for educational software comes from several sources: it might be siphoned sideways from textbook allocations, or other non-specific bikkie tins like library funds or disadvantaged schools grants; a lot of money is also coming from Parents and Citizens Associations; and parents themselves are spending generously. Tim Bennett from Applied Technology calculates parents may be footing 80 per cent of the bill for school computer equipment and software. Mary-Louise Parkinson from Apple thinks this figure may be even higher – as much as 95 per cent. When you consider such estimates in relation to the fact that the Federal Government has recently pledged $18 million in grants for computer education, and states are planning to match that on a dollar-for-dollar basis – you can understand vendors stampeding for the education dollar.

Apparently, the market has been through several phases since it began. "The capital investments trauma is over," says Alistair Campion of Ashton Scholastic's software arm, Ashtron Software. "P&C groups are seeking and giving advice. Individuals, usually computer literates, are introducing computers in schools, and resource centres are advising on hardware and software. The 'maths problem' continues – where computers are tied up in science areas, and social sciences are disadvantaged."

Stefan Wasinski of Barson Computers, distributor of the BBC Micro, thinks the market has evolved even further. "It used to be that schools wanted a box for the lowest price, and often the result was a cupboard full of unusable, though very cheap, equipment. Working software was just a plus. Now the market is more mature; the computer press has been a forum for views, people are better educated, there is more advertising. Where people used to say, 'Tell us what we should buy', they are now saying, 'give us this because ...' Many educational buyers are more mature than commercial buyers."

Wasinski thinks things will continue to improve with more computer courses, and with knowledge being passed on from experienced teachers.

The Computer Reaction

It seems the end users in this most lucrative market are happy to co-operate in lining the corporate computer pocket. Kids take to computing like the proverbial duck to water. Apple's marketing manager

David Roman says, "The rapport between the child and the computer is very good. Kids like action and speed, which makes a computer ideal for the job. Children work better, more neatly, using a word processor, and they actually prefer to use computers – it's not just a novelty."

Parents, however, generally don't feel the same affinity for computers as their offspring. They have a much more wary approach, and tend to simplify the need for computer education. According to Sharon Ottery, "Parents feel their kids will benefit from contact with computers. They don't know about computers themselves, but think their kids will need to know about them to get a job. That's a little short-sighted. Most of the jobs they are being trained for won't be there in a couple of years."

From the teacher's point of view, the rush to 'get computerised' has left many of them at a loose end. Again, it's the older members of the teaching force who tend to respond negatively to the idea of computers in the classroom. "There is fear amongst the older generation," says Stefan Wasinski. "Experienced teachers have a natural reluctance, while younger teachers have embraced computers more readily."

There's also a marked difference in enthusiasm shown by teachers in subject areas. English teachers in particular seem to show hostility toward computing, through fear of the great unknown. Spokespeople for several different companies saw this as a pity, saying many of their best packages could be used to foster creative writing.

In Various States of Organisation

Representatives from a number of companies also commented on the computer centres set up by various state governments to support education in schools. They spoke of South Australia, Western Australia and Tasmania as being the most organised. The bigger states are apparently moving more slowly, partly because of their size and the number of people who need to be consulted before a decision can be made.

According to Tim Bennett of Applied Technology, the education units in larger states are out of touch; they are unaware of what computers are being used for in schools. He points out the gap in staffing between New South Wales and Western Australia: the former has ten full-time programmers while the latter has a staff of 20 and has been in operation for ten years.

Sharon Ottery has a similar view of New South Wales and Victoria: "They don't know what they are doing; there is not enough education of teachers, and very little advice available."

Alistair Champion forecast that, "The guys at Erskineville (the New South Wales centre) have a long uphill battle. Things are still highly confused, but will be sorted out in the next 18 months."

The Government Role

State governments are involved mainly in specifying machines that they approve for use in schools, and in funding purchases. Through the computer centres, they are trying to give further direction to the development of the computer education scene. But the push still seems to be in other hands. Schools are only required to buy machines on government contract if they are using government money. In some states, Western Australia in particular, the government provides all the state schools' computer requirements, while private schools are able to depart from the approved machines.

Education Market

The contract system has advantages and disadvantages for computer suppliers. "If you are not on a contract, it makes the decision more difficult for the buyer," says Tim Bennett. "Contracts help sales because many buyers are naive, in some ways, and the choice is narrowed for them."

Other companies agreed with this, pointing out that the fly-by-night vendors tend to get weeded out under the contract system, leaving the field to serious computer suppliers. All vendors saw it as vital to be on as many, if not all, of the contracts, to ensure healthy levels of sales.

One problem with the contracts arises in the area of dealer support. Alistair Campion says, "Departmental tenders are undercutting the dealer base, giving rise to the question 'Who is giving support?' You end up with governments acting as dealers because dealers themselves refuse to support machines they didn't sell."

Like some computer education centres, government bureaucrats are criticised by many computer companies for being out of touch with the computer education situation as it really is in schools. However, Barson Computers is one company which believes a better general understanding of computers will improve this state of affairs. Says Stefan Wasinski, "Government personalities have become less afraid of computers. They now see them as a tool, and try to get the best mileage out of their purchases."

Every company interviewed said that where governments are articulate and informed it is much easier to define the market and develop new products. If people know what they want, it is obviously easier to supply their needs.

It should also be noted that software is not on contract in any state, but is usually purchased by schools. Government departments do buy some products, usually in bundles of around 200 copies, which are then distributed among schools.

Spokespeople for two Queensland-based software suppliers, Arcom Pacific and Jacaranda Wiley, complained that schools always expected "an arm and a leg" when purchasing software, believing that their educational status precluded them from considering either authors' rights or the money suppliers need to make from each package in order to survive.

Lobbying the government in this area is apparently a very delicate business. "There is an informal involvement with governments," says Alistair Campion, "but the area is highly political and governments don't like being seen as connected with commercial interests."

There are few official channels for companies to keep in touch with governments, though Apple has been active in the education group of the Australian Computer Equipment Suppliers Association, and in Commonwealth Schools' Commission Committees.

Other lobbies do exist, such as PriMUG, which stands for Primary Schools Microcomputer User Group, a New South Wales body with 280 primary school members which has had a strong influence on the New South Wales Education Department.

Despite the abundance of different groups which have some say in how computers should be used in education, the ultimate decisions rest with the schools themselves. From a sparse presence in mathematics classrooms a few years ago, computers are slowly finding their way into every level of education and in every type of course.

IBM has put a great deal of effort into cracking the schools market. Popular though he may be, the machines Darth is supposed to sell are still too expensive for most educational institutions.

The Size of the Market

With about 12,000 schools in Australia, hardware and software companies have a very large potential market for their products. At present there are said to be some 30,000 computers in Australian schools. The available statistics are somewhat dubious, but the breakdown of computer brands is roughly as follows: there are about 10,000 Apples, 8000 Microbees, 5000 Commodores, 4000 BBCs, 2500 Tandys and 1500 Atari machines. IBM is thought by most people to have about 300 machines throughout the education system, including the 200 it gave away.

Publisher McGraw-Hill is currently marketing around 65 per cent US software and 35 per cent Australian. The company is aiming for a ratio of 40 per cent US software to 60 per cent Australian product. At present software sales are a minuscule part of the company's earnings, but McGraw-Hill executives anticipate they will eventually represent about 15-20 per cent of the company's overall profit (which will include home and business software).

Ashton Scholastic believes it currently has 65 per cent of the educational software market, and Campion says the company's sales have tripled in the last twelve months. He believes the figure claiming around 8000 Microbees in Australian schools is correct, and that Bees will provide the next big, as yet untapped, market for software in Australia.

For Applied Technology the education market is extremely important, with 30 per cent of sales being made directly to schools. The company believes the flow-on of sales from this area represents another 30 per cent of Microbees sold. In one case, for example, Applied Technology sold 15 Microbees to a school and 30 to the students' parents.

According to Phil Woolley of Imagineering, by 1986 there will be computers in four out of five schools in this country. Sales in the education area currently account for around 10 per cent ($1.8 million) of Imagineering's annual takings.

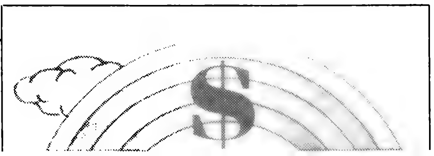
The BBC computer was designed for education, so, naturally enough, Barson Computers is dependent on the school market for sales of that particular machine. The company sells 70 per cent of its BBCs direct to schools, and almost all the remainder are accounted for in flow-on sales.

Apple believes it has a stranglehold on the education market. It relies on schools for 30 per cent of its sales, and, like Applied Technology, believes these sales into schools are doubled by the sales they generate in the home market. In the US, figures suggest that for every Apple sold to schools four are sold to parents.

It is impossible to assess the potential dollar value of the market. Although government grants can be added up, the contributions made by parents are incalculable. Quite simply, parents seem to be willing to supply enough money to provide a school with what it wants. If the school wants enough money to buy one computer, the P&C will raise it. If the school wants to buy 15 machines, the P&C may take a little longer, but it will still raise the money. In this situation, the level of demand will determine the size of the market much more than the amount of money apparently avail-available.

Marketing Strategies

There are a number of techniques used to tackle the sprawling education market. For instance, IBM has a three-pronged approach, based around spending big bucks, to try and muscle in on a market many think PCs are unsuited for. The company's most obvious ploy is its education show, aimed at increasing computer awareness, but also a handy vehicle for getting people comfortable with the IBM way of doing things. IBM also provides training courses for teachers ▷



Education Market

interested in PCs and who want to know how to use one in their classroom. This is especially aimed at the secondary schools market. Then there are the giveaways; IBM has donated around 200 machines to organisations running teacher training courses. The idea is that people who learn on an IBM are likely to buy PCs for their schools.

A fairly representative example of how companies are approaching the education market is publisher McGraw-Hill. It has a small marketing budget, to help keep software cheap. "Our pricing is based on what the product costs and what the market will bear," says Sharon Ottery. The major investments made by McGraw-Hill in education are employing Sharon, an ex-teacher, buying two computers (an Apple and a BBC) and paying for any contract work required to bring a product up to scratch.

McGraw-Hill's software is geared to government directives that programs be for computer-assisted instruction. Sharon Ottery has found that if a product enhances teaching, teachers will buy it.

McGraw-Hill already has a large force of representatives visiting schools and selling the company's books. These are now being utilised to market software, after being trained to use computers and the software packages they are selling.

Dealerships are also being developed. Organisations like the University Co-op Bookshop are being given dealership of McGraw-Hill products, subject to certain conditions. They must, for instance, have a computer on which to display products, and a person trained to demonstrate them. McGraw-Hill is also marketing software through regular computer hardware dealers. Eventually, Ottery hopes software will become a mass-market commodity, sold through large department stores

Some McGraw-Hill programs have been used as marketing aids for textbooks. A diskette in a book sleeve may only be worth a couple of dollars, but helps to significantly increase sales of the book itself. McGraw-Hill also distributes demonstration disks of programs, which give potential buyers an idea of what various programs can do. This tactic has mixed success, since teachers inevitably want to see how the real program works after they have seen the demo – nevertheless, it's a good way of increasing awareness of the company's products.

Media reviews of products are valued highly by most software firms. Reviews are considered to have greater effect than advertisements – provided the reviewer's comments are favourable.

One of Ashton Scholastic's main selling techniques centres around its product list. This is distributed nationally, using a mailing list which is frequently updated to include as many potentially interested parties as possible. Ashton Scholastic supports this list with product sheets that give details on what a product does, and suggestions on how it can be used in the classroom.

Apple has a similar strategy, implemented via its magazine *Apple Education News* which is distributed to around 12,000 teachers. This magazine covers new developments, and areas where computers are proving successful in education.

As teachers have become more selective and informed in their choice of software, the importance of supplying products with good, Australian content has grown. According to Phil Woolley of Imagineering there is a lot of resistance to packages imported from the US. Some software companies specialise in 'Australianising' software for the local market. Often the changes required are only cosmetic, such as altering American spellings.

Applied Technology regards its Australian 'nationality' as one of its major selling points. Says Tim Bennett, "We have a large R&D force producing 100 per cent Australian software. We have cottage-industry-style production of packages which sell for only $10-$15. People are becoming conditioned not to pay any more than that, so other companies are having trouble matching us. It also means we are able to react quickly to market demands."

Many educational software companies have relied on selling their products through computer dealers, a method which has turned out to have more problems than selling business or games software by the same means. "There's a Catch-22 situation," says Phil Woolley. "If pricing of educational software is too high, dealers won't stock the product because they think it will be pirated in the schools. But then the product becomes scarce, and it gets pirated because it isn't available from the dealers."

Imagineering is countering this problem by targetting its training programmes at dealers. It also aims to increase computer awareness in the relevant government departments, by offering to give demonstrations of the possible uses of computers in schools.

Most companies regard the various computer shows, such as the Australian Personal Computer Show and National Education Show, as very important, but are a little more sceptical about the value of attending school computer fairs. "It's impossible to attend all the computer fairs," says Stefan Wasinski. "We are invited to three a week. We don't have the resources to attend them all. They tend to be fund raisers for the schools, anyway, with little benefits for computer companies."

Other companies see the fairs as just another way for schools to make more money. Some schools are asking as much as $2000 for the dubious privilege of having a stand at one of their fairs. Of course, some of the fairs are very successful, with strong attendances and lots of exposure, but few generate sales, and almost all take up the weekends of already overworked computer staff.

Apple's marketing has been one of the most successful in reaching the educational buyer. The company has compiled a profile of the typical Apple purchaser. According to David Roman, this person is an achiever, confident and knowledgeable. He or she earns a reasonable income, is well educated and has children. Apple buyers are quick to adopt any new technology. They own a good quality VCR, have a microwave oven in the kitchen and, if they have a camera, it will be highly sophisticated and have lots of accessories. Roman also believes these people are behind the purchase of computers in most schools.

This profile may well be based more in flattery than fact, but it does give Apple a useful target for its advertising.

To address this market, advertising campaigns have been concentrated on prime-time television; Apple ads appear during newscasts and popular movies. You'll also see them in the quality press – publications like *Time*, *The Bulletin*, *Harpers Bazaar*, and *The Financial Review*.

In addition, Apple directs a lot of effort to the various trade shows, and provides teacher training courses.

Apple's Education Foundation also gains the company market exposure, while helping to fund software development. The foundation makes grants of hardware to schools and institutions which want to work on specific projects in the education field. It's part of Apple's worldwide policy to help the communities in which it operates.

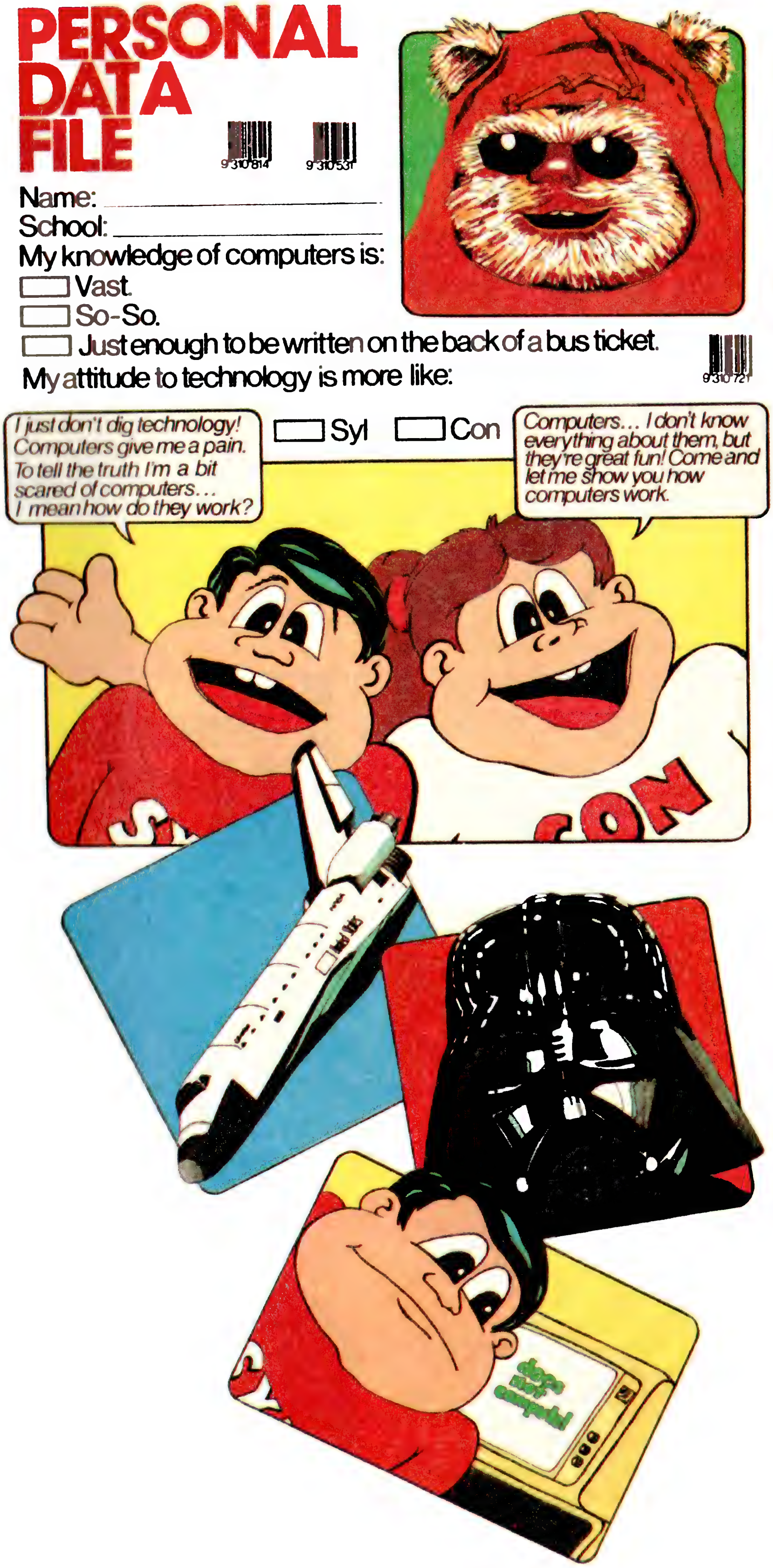
Competition

At the moment it would seem there is plenty of elbow room between companies in the educational software market, however competition in the hardware area is driving some companies to take drastic measures.

Sharon Ottery says the software market could easily support more publishers. The scarcity of suitable software to publish is the only aspect in which competition becomes serious. "Finding good authors is a talent," she says. "We're always on the lookout for small companies with software. It gets competitive bidding for them, and we often find we are paying more than we really want to."

The main players in the software market are companies like Jacaranda-Wiley and Control Data, though even they have their problems. Ottery believes Jacaranda is producing some superb software, but is disadvantaged in not having a large overseas network through which to sell it. Control Data's Plato series of educational software is only just starting to make money, after many years of development.

Alistair Campion of Ashton Scholastic agrees with Ottery's view of Control Data. He thinks the company's main problem is that it is not set up for retail sales. He sees most of his competition coming from the big book publishers – McGraw-Hill, Holt, Brittanica and Pitman – but ▷


PERSONAL DATA FILE
Name:
School:
My knowledge of computers is:
☐ Vast
☐ So-So.
☐ Just enough to be written on the back of a bus ticket.
My attitude to technology is more like:
I just don't dig technology! Computers give me a pain. To tell the truth I'm a bit scared of computers... I mean how do they work?
☐ Syl
☐ Con
Computers... I don't know everything about them, but they're great fun! Come and let me show you how computers work.
CON
does not compute!

still feels there is plenty of room in the software market.

Campion does, however, give one warning. "People are rushing in and coming unstuck," he says. "You need to be highly professional in a market that stretches from kindergarten to university. Specialisation is the key; you need to pick an area and focus on that."

He also thinks most purchases are decided more on price than on content. As a consequence, schools are not happy paying large prices for average software. The key issue in this area is that often schools are using public money for computer-related purchases and therefore have to account for what they buy. This should gradually force prices down while quality improves.

According to Campion, the main machines in the marketplace are the BBC, Microbee and Apple, and to a lesser extent the Commodore and Atari. IBM's marketing position with the Junior is still not clear and, says Campion, "The PC is primarily an administration machine, not a literacy machine."

The staff at Imagineering sees the Commodore 64 as one of the major competitors, and is giving it a lot of support alongside the Apple and IBM, CP/M machines, Wang machines and the various IBM clones.

Phil Woolley believes you have to sell about 4000 to 5000 copies of a program before it can break even. He says the government, in its role as a bulk buyer and distributor of educational software, is of major importance to educational software sales.

Many software companies are using price cutting as a marketing strategy. Their price scales generally start at around $40, go up to $50 or $60, and then jump to packages marked $100 or more. The ultimate aim is to get the common price down to about $15 and sell large numbers of copies.

Applied Technology has already succeeded in this aim. It feels the combination of locally produced hardware and software is one of the most cost-effective solutions on the market, and that this is one of the main reasons for its success. Applied Technology's software base is quite large; its sources include Goodison, Nectar, J&H Beesware, Graycol, Flying Fox, Dreamcards, MMD Software and JD Milne.

Applied Technology believes its main threat is the BBC. Tim Bennett said he considers the Apple outdated, and that the IIc suffers the same slow disk drive problem as the II. He described the BBC as the best machine on the market, but way overpriced. "If the price drops we could find the competition a lot harder," he speculated.

Strangely enough Barson dropped the price of the BBC just after our interview with Applied Technology, and is expecting to treble sales of the BBC as a consequence. The staff at Barson thinks the BBC is competing in the top end of the marketplace, with machines like the Apple. It sees its key selling points in the fact that the BBC is a reliable networking machine with good support.

Apple considers its position to be very strong, claiming the largest installed base, a huge amount of software and more expertise than anyone else in the market. When asked to comment on the competition, David Roman described the BBC as a good low-cost network, the Microbee and Commodore as low-entry-point machines for people who cannot afford anything better, and the Tandy as a machine which suffers from not having a good upgrade path.

Education Market

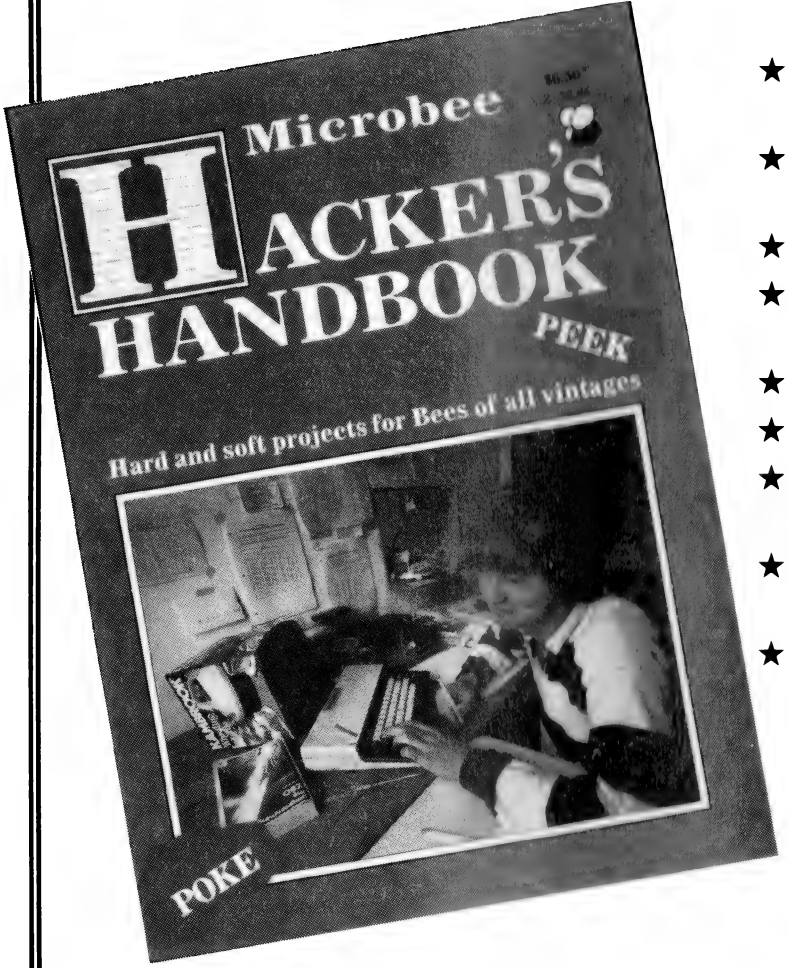
To this Roman added, "Each company has its own niche. There is room for other companies, especially in the primary schools area." However, he believes it is getting very expensive for new players to enter the market, due to the strength of the firmly established vendors.

Apple answers the charge that the Apple II is outdated by pointing out that the machine is continually being upgraded to keep pace with the market. Products like the mouse and the Apple hard disk were mentioned to illustrate this point. Roman also claims that major publishers of innovative software usually decide to produced it for use on Apples.

Roman summed up Apple's attitude to computers in education saying, "It's not just a matter of market share, it's a great way to get involved in education." ■

Microbee HACKER'S HANDBOOK

The Microbee Hackers Handbook will tell you how to:



Microbee HACKER'S HANDBOOK

PEEK

Hard and soft projects for Bees of all vintages

POKE

★ get more from the Bee's graphics capabilities,

★ set up for telecommunications on the Bee,

★ play music on the Bee,

★ build a joystick and a light pen for the Bee,

★ get hard copy — cheaply,

★ expand your 16K Bee to 32K,

★ make the Bee a better games machine,

★ turn your Bee into a facsimile decoder,

★ solve equations on the Bee

. . . and much more!

From the publishers of 'ETI' and 'Your Computer' magazines.

We've also included listings of the Bee's BASIC scratch area and machine language locations — to make the Hacker's pursuits easier.

For sociable Hackers there are the contact addresses and phone numbers of all known Microbee user groups.

$6.50 Aust. ($6.95 NZ) at your local newsagent.

Education & the Home Computer

Do you feel obliged to buy a computer to enhance your children's education? A great wad of advertising dollars has been spent on making parents feel that pressure. We asked the researchers at Horan, Wall and Walker, 'The Information Agency', to find out whether buying a home computer is warranted in terms of the educational benefit to be derived from it.

Schools across Australia these days are forsaking antiquated teaching devices for computer systems in varying degrees of sophistication.

Everywhere parents are selling raffle tickets and organising jumble sales to help their local school raise money for Apples and Microbees, to push the school-based microchip boom along.

These days no primary school, high school or kindergarten is considered educationally equipped without VDUs, disk drives, printers and other bits and pieces. But what about computers for education at home? Is it still good enough to let your child shoot at on-screen Atari space-men? Or should you install a more sophisticated machine to allow your child to practise word processing and data manipulation at home?

MY GRANPA & GRANMA ARE BUYING ME A COMPUTER...HERE'S A PRINTOUT OF MY NEEDS...

Advertisements for constantly changing computer systems insist one ought to take the home computer plunge. But has anyone taken time to look beyond the confusing technological hype?

Computer whizzes across Australia have had to put aside their high-tech manuals to look at this very problem, one of the many new ones arising from the current microprocessor revolution. It's a problem that has seen many concerned parents duped into making expensive computer purchases without knowing whether they are doing the right thing by their child's education.

Computer Parents

Like the stage-struck mothers of the '30s , parents of the '80s have taken to reassuring each other that their child will have a better and more prosperous future because they have made the ultimate mortgage sacrifice – to buy the best system, or apparently the best, for their golden-haired offspring. Mums and dads at suburban cocktail parties and barbecues have taken to dropping the names of software packages and swapping ideas on local computer bargains.

For this reason, the experts agree that what is really needed at this stage of the computer boom is a thorough revision of computer jargon, minus the sales pitch, so that parents can understand what their role should be in the technological transition.

After all, most parents admit they

are truly in the dark about the silicon chip, especially when they are still adjusting to metric measures and microwave ovens.

Education departments in all states, and both private and public school systems, now have computer systems with implementation policies to match. Tasmania, for example, has a complete on-line system which is logged onto by all state secondary schools and some primary schools. Schools in other states, including Tasmania, South Australia, Victoria, Western Australia, New South Wales, Queensland and the Northern Territory, have sophisticated computer systems that vary in quality and performance, but which are mainly used to instruct children from kindergarten to Year 12 in computer awareness.

Rarely is there an emphasis on programming, as it is considered that computer programming will not be a main occupation in the future. Perhaps it will be an elite one – but the experts say programmers will not be in big demand.

Schools mainly concentrate on computer-based learning approaches that will help young people adapt to technological processes. Day to day tasks will eventually become computerised, taking over a large sector of manual work.

Not many parents realise that this is the case and try to justify expensive home computer investments by saying a machine at home, whether it is as good as, better than, or inferior to the one their child is using at school, will inevitably improve their child's ability to cope with future technological change. This line of thinking is often accompanied by a belief that learning how to program a computer is the main reason for installing one at home.

Overestimation Danger

Ex-teacher and senior lecturer at South Australia's Angle Park Computing Centre, Dean Rosenhain, says there is a danger of overestimating the need to back up school-based computer studies by installing a VDU in the loungeroom.

Speaking from his experience as an educational policy support adviser and in-service teacher of parents as well as computing teachers, Rosenhain believes parents risk confusing their priorities when they commit themselves to encouraging children to log on at home as well as at school.

According to the Adelaide-based educator the software available for home computer users is still fairly ▷

...IF WE DON'T BUY A COMPUTER, OUR CHILDREN'S FUTURE WILL BE LEOPARDISED!
JEOPARDISED, SWEETEST...
OH...
ARE JEOPARDS DANGEROUS?
Your Computer
Computer

pedestrian in its approach to computing processes, even though parents think it's educational.

"It's a bit like the argument that the child won't be able to become an engineer unless he has a Meccano set – does it mean he will cease to be interested and give up? " he said.

Rosenhain also said, however, that there were some valuable skills to be learned from the existing software available for relatively inexpensive home computers, such as some of the cheaper Ataris or Commodores.

Problem-solving skills, reading, geography, map making, decision making, accuracy, reflex responses, and some more esoteric skills such as social management and interaction, could all be learned from certain computer games, he said.

Some adventure games emphasise the need for the computer operator to develop these talents, and many other games encourage children to become involved in programming for pleasure.

But overall, educational software has so far failed to teach learning concepts to match the new technology. 'Education-by-computer' is apparently still based in the school room, without taking advantage of what the chip has to offer. So far, educational software is still linked through the archaic blackboard approach to the three 'R's.

In this sense children are not disadvantaged educationally if their parents don't have a Macintosh or IBM at home like the one at school, because the computer cannot yet teach anything that couldn't be learnt in another way.

Computers at home can, however, encourage children to learn basic commands and develop a certain level of awareness, but as yet these skills are not imperative. Says Rosenhain, "I can see a time when children will do all their homework on the computer – but it's not here yet."

The Haves and Have Nots

Kevan Penter of Western Australia's Educational Computing Association said the most important factor to watch in home computers was the possibility of a new class division developing between the computer haves and have-nots.

"I'm not an ardent and outspoken socialist or anything, but I wouldn't want to see a whole sector of society denied the chance to get to understand computing just because their parents aren't well off enough to afford an upmarket Commodore for home use," said Penter.

"But then it all depends on what is available at the school," he continued. "Every child should at least get to know the basics, so they are not left behind by kids who have unlimited access to a computer in their own family circle."

Teaching Parents

The Director of Education Services for the New South Wales Association of Independent Schools, Colin Woodley, has been involved with computers for more than 20 years. He boasts 17 computers at home.

Under his supervision the association has begun special parent and teacher training courses on the evils and benefits of home computers. In a bid to crack the advertising push associated with technological investments his organisation is holding sessions three afternoons a week on how to make a sensible computer purchase.

> ***"Mums and Dads have taken to dropping the names of software packages and shopping ideas on local computer bargains."***

Woodley says the association has been swamped by parents who are keen to join the seminars, and they are now booked out months in advance. He attributes this response to the fact that parents are slowly becoming wise to the overwhelming flood of glossy computer advertising. They have finally started to understand that computers are fickle creations which fast become obsolete and often useless for educational purposes if the right choice is not made.

According to Woodley, who also describes himself as a "concerned parent", the computer seminars are designed to get parents who are looking at computers away from salesmen. Up to seven different brands of computer are set up side by side and parents are told, by university-educated computer specialists, what each can do, what software it can utilise and whether it is good value for money.

"Too many parents have been cajoled or confused into making a purchase which is entirely wrong for their family," Woodley said. "It's our experience that computers don't suit all families or every home environment, or the various attitudes of children. If a family isn't attuned to the educational needs of the children there's no point investing in a computer."

In Woodley's opinion children won't yet suffer if they come from a home without a computer, because the technology is too new. But the skills children will need to operate word processors and data systems are going to become increasingly necessary, when computer-based tasks become more common.

Wrong Choice

According to Roger McShane of the Elizabeth Computer Centre in Tasmania, people tend to buy home computers for the wrong reasons. "They seem to buy a computer and see what they can do with it, rather than asking themselves what they would like to do with it," he said.

But he believes buying a home computer for your children depends on what computer facilities are available through the school, and says, "Most schools tend to buy more expensive machines such as Apples and IBMs, which are more powerful and more versatile than most parents could afford to buy for their homes, anyway," he said.

"It's no use buying cheap home computers that can't function on good educational software. And a lot of these less versatile computers can also give children bad programming habits if their limited software is not well designed."

Old Before its Time

Sydney engineer Graham Beatty set up an NEC PC 8000 in his home a few years ago, hoping that, in time, his children could be among the new breed of screen-watching toddlers. Since then his son and daughter have reached seven and nine years of age, prime time to 'log on', but he says his computer has grown obsolete. Beatty is unable to buy educational software that will run on the now outdated 8000, which was designed for business anyway and therefore wouldn't have attracted educational software development.

Beatty eventually decided something had to be done to safeguard educationally concerned parents from this new micro-chip consumerism, and became involved in school computer policy work for the Federation of Australian Parents and Citizens Associations. In 1983 he sat on the New South Wales Education Department's Secondary Schools' Board Syllabus Committee, and was part of the Curriculum Project Team for Computer Education.

Even though investing in a computer for educational purposes was, for him, a bad experience, Beatty believes home computers can be a very valuable investment in supplementing a child's education – as long as sound educational software will continue to be available to help expand the child's computer literacy.

"Computers at home are very much under-utilised," Beatty said. "Most parents and kids wouldn't know what to do with them beyond playing games. But at the moment it seems to me there isn't enough good educational software available to justify spending a lot of money on a home computer." Ultimately, Beatty says, he would like to install a special on-line network in his house; incorporating terminals in the kid's rooms, a printer and main terminal in the study, and a small disk drive machine in his office at the Electricity Commission. He predicts this move could become affordable within the next five years, given the way the micro-chip revolution is going.

The experience of his policy work, from the parent's point of view, still allows Beatty to concede that parents should be making the effort to ensure their children have at least some computer awareness training from home.

The New South Wales Education Department's computer policy states that children should at least attain basic computer literacy; it says the time will come when computer literacy will be essential.

"I can see a situation when we'll be doing our banking, our shopping and everything from home," said Beatty. "Our home computing will rely on databases, and a knowledge of transactions, transfers and all kinds of processes. Our children will need to know how to use these processes, and I can even see a time when their study will depend on databases which take the place of encyclopedias."

According to the experts, the day when a home computer is a necessary adjunct to education has not yet reached us, but a sensible purchase, coupled with a few parent seminars on how to use a home computer wisely, wouldn't be wasted. ■

How to Shop

When shopping for a home computer you might keep these basic points in mind:

- First, look at your family's needs. Try to work out, rationally, if you really need a home computer or are simply tempted by the new technology. One way to do this is to look at your consumer spending in the past – have you, for example, invested in most new technological gadgets only to find that the kids break them or they, and you, lose interest fairly quickly?
- Work out what you want a home computer to do before you start looking around the slick technological marketplace. A good salesman will always convince you to buy something you might not really need.
- Make sure the model you buy can run new and constantly changing software. Children become bored with repetitive games and limited 'educational' programs, and lose interest despite their initial addiction to the terminal screen.
- Have a talk to a computer specialist first, one who isn't a salesman, to help you decide what kind of things the family would want a home computer for.
- Talk to your childrens' teacher and find out what he or she thinks about the use of computers for educational purposes.
- Talk to your children, and try to make out whether they would really stay interested in a home computer – especially if you can't afford a machine as advanced as that at school.
- Be honest with yourself. Would you really use a private system to process your accounts, or list your cooking recipes, as suggested by some?
- When you finally buy, make sure the computer will be suited to all your needs, and to the children's.

Girls and computers

What's happening with girls and computers in schools? The answer appears to be 'Not much ... and a great deal'. In the rush to have a computer in every school, policy development with regard to access to computers has been lagging behind, with the result that girls have found themselves in something of a technological wilderness. It is only recently that attempts have been made to redress the balance.

Studies in the UK, the US, Canada and most Australian states indicate girls are the losers in the race for computer literacy. And it *is* a race – US government figures estimate by the early 1990s 50-75 per cent of jobs will directly involve computers in some way. Surveys also show girls are aware of this fact – a Californian study found three-quarters of twelfth grade girls agreed "a knowledge of computers would help to get a better job".

The Computer Image

So why are girls lagging behind? Looking around it doesn't take long to see a variety of social factors influencing the relationship between girls and computers. Probably the first is the maths/science image of computing, an image which is unjustified these days. This image has been perpetuated in many schools where the computer has become the property of the maths department, a domain long dominated by men.

A second factor is parents' willingness to spend money on furthering little Bill's educational prospects, by forking out money on a home computer, but not on little Mary's. This is backed up by advertising images overwhelmingly geared towards boys. No wonder in 1983 it was estimated that 93 per cent of home computers in the US were in the hands of males.

While the computer as a machine has become the latest toy for the boys, software for home microcomputers has apparently developed largely as an extension of games arcades (a cursory glance in any of these will show who are the habitual occupants), with shootouts standard fare. A good percentage of 'educational' software has followed this shoot-em-up trend, with titles such as 'Maths Invaders' and 'Type Attack' commonplace.

It's pretty obvious girls feel excluded from exploring computers, and that this exclusion is not a new phenomenon – it is an extension of women's traditional exclusion from areas of science and technology. It is also a reflection of the rigid sex-typing of jobs which occurs in the Australian job market: an OECD comparison in 1979 revealed that, of the countries studied, Australia had the highest degree of occupational segregation of men and women. In that year over 85 per cent of women in the workforce were concentrated in 18 of the 61 occupations listed by the statistician; over half the female population was concentrated in five occupations – clerical workers; sales assistants; stenographers and typists; housekeepers, cooks and maids; and teachers. It is these female-dominated occupations which are increasingly and disproportionately threatened by technological change. Perhaps it's not surprising that women and girls are less inclined to embrace computer technology than men.

The Task

Our schools are thus placed in the difficult position of trying to overcome a variety of historical, social and economic factors which militate against girls becoming involved in this new technology. Somehow, they need to make computing relevant to girls, and provide them with the tools necessary to understand and manipulate computer technology.

In the past 18 months, the various education departments throughout Australia have not been idle. The Commonwealth Government has identified the needs of girls as a Special Initiative, with a high priority. (Also included in the Special Initiatives area are special education, Aboriginal education, students from non-English speaking backgrounds, socio-economically disadvantaged groups and isolated students.)

In New South Wales, as a result of proposals from schools, the Computer Education Unit has recently trialled a module called 'Meeting the needs of girls in computer education'. The aims of this module are to raise people's awareness, examine attitudes and suggest actions to be taken around girls and computers. The trialling

In introducing computers to children it would not have occurred to most people to think of girls as a group likely to be disadvantaged. However, research and observation in this area has revealed that traditional ideas about technology are affecting the ways girls approach computers. Here, Rose Vines looks at what can be done to give girls an equal opportunity to compute.

enabled female and male teachers from a variety of backgrounds (city/country, primary/secondary, computer 'literate'/ignorant) to assess the module's usefulness and content, prior to it being introduced into New South Wales schools this year. When made available, the module will provide a useful resource to teachers trying to involve girls more in computer education. However, use of the module will not be mandatory.

In South Australia, a Girls and Computing Project was undertaken in 1983, with the aim of identifying factors influencing girls in computer education and developing strategies regarding these factors. In her report, Lynne Symonds, the Project Officer, said very little was happening in the area most people regarded as of primary importance – the use of computers *across* the curriculum. Taking computers out of the maths classroom and introducing them in all areas – English, social studies, history, and so on – was identified as the direction in which computer education should be heading. But, "because of a strain on resources ... it was just not happening."

Other priorities identified by the South Australian project (and echoed in other studies here and overseas) were the need for course content to involve girls; making women's contribution to computing visible and providing positive role models for girls (that is, "competent, confident women using computers in a computer class or in their history class, without being scared of the technology").

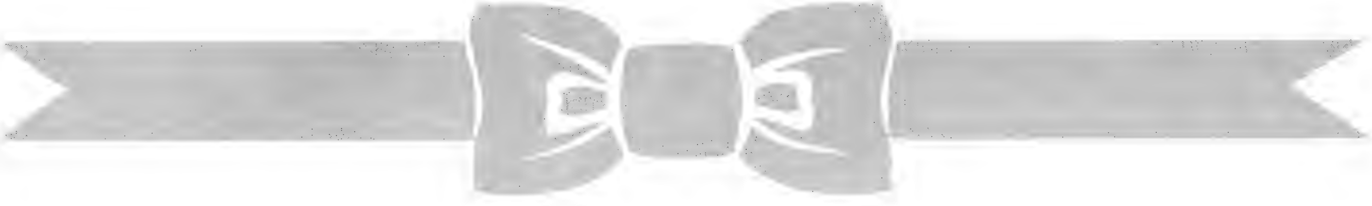
Unsuitable Software

Many girls find computer studies irrelevant, with the emphasis on programming, or software which is based on violence or which excludes or negates women's experience. Little time is spent on the social implications of computers, and good ▷

Girls and computers

software is still rare.

Software which *did* meet with approval in the South Australian study was 'The First Fleet Data Base', which is regarded as outstanding for the amount of gender-inclusive material contained in it, and some word processing packages. Many girls are attracted by word processing software, and Lynne Symonds reported on a creative writing project called the Mitcham Primary Experiment: "The wonderful thing about improving the lot of girls in education is that it does wonderful things for the boys. The worst writers in primary school are boys. We found using word processing and Bank Street Writer at primary school level involved the girls in computing because they could write stories using them. We know girls are good at writing stories and their language development is good. But for the first time boys, whose work had always been scrawly, who hated writing sentences because they had to rub them out, could hand up beautiful, clean pieces of work."



Computing Heroes

Women's contribution to computing has been largely ignored, and yet the South Australian study found that mention of women such as Ada Lovelace (the first 'programmer') and Grace Hopper (the driving force behind many computing developments, including the language COBOL) had an enormous effect on girls. Also vital in attracting girls' interest were positive female role models. Various schools reported the impact of having just one female teacher actively involved in computing, especially if the teacher was not a maths/science specialist.

Further strategies which have been suggested to encourage girls to be more involved in computer education range from structural procedures to examination of the language used in computer classes and software. Sometimes simple things such as timetabling can exclude girls from participating, and it's amazing how a small amount of positive discrimination (such as girls-only times for computer access) can boost girls' self-esteem and responsiveness to computing.

All these ideas and strategies are now being examined by Australian education departments. It is up to the broader teaching community to examine their own attitudes and implement the proposed strategies, in order to give girls a chance to understand and participate in current computer technology.

Avoiding a Superseded Knowledge

But will that be enough. Susan E Moont, in her paper 'Will Women Be the Drop-outs of the Information Age?', raises doubts about current approaches to teaching girls computer studies: "I have deep concerns about specially structuring circumstances so that girls will learn about computers. What I suspect will happen if we adopt this strategy is that girls will learn about the current technology. As soon as it changes they will have to learn about it all over again. What they have to learn is in fact *how* to learn about technology."

Moont believes we should be teaching exploration strategies, "coupled with some training to determine when the use of strategies is important".

Perhaps the critical factor in getting girls involved in computer technology is power. At present, computers represent the epitome of male technology, answering the economic and social needs of male social structures. For women and girls, computer technology offers more of a threat than a promise, because the interests of economic 'progress' and efficiency seem to be in conflict with the immediate interests of most women.

Looking at the workforce, computers have drastically affected traditionally female occupations. Claims that computers don't eliminate jobs but merely restructure them have yet to be substantiated. It is estimated electronic data processing has the potential of processing 15 per cent of all office work (the equivalent of around 22,000 jobs), while word processors can do the work of at least three to four typists.

This erosion of women's jobs is likely to accelerate with changing technology. Optical character recognition, at the moment in its infancy, is likely to eliminate most data entry jobs. And while women are at last being encouraged to venture into other computer-related careers, including programming, opportunities in these fields are diminishing. Within the next ten years computers will take over these tasks more and more, and it seems women will begin participating in larger numbers only when the 'elite' computer jobs have been de-skilled. Jobs which seem likely to survive intact, such as systems maintenance and engineering, remain male domains.

Moont's idea of teaching girls how to learn about technology is one way in which girls will be able to cope with and analyse technological change. Knowledge such as this will be an essential tool for survival as computer technology comes to dominate our lives more and more. Without such knowledge, women and girls will end up victims of technological change. As Jan Zimmerman puts it in her paper 'Technology and the Future of Women: Haven't We Met Somewhere Before?': "Women will find themselves dealing with the world of tomorrow using yesterday's tools, the technological hand-me-downs of their brothers ... to subvert some of these technologies to their own ends, women must extend their spheres of organisation and influence ... and start to chip off projects which use and control technologies to their own ends."

Unless schools can offer girls some hope of a place for them within tomorrow's technology, and the power to determine the nature of that place, computer education will remain irrelevant to the vast majority of this half of the population. ■

"Female-dominated occupations are increasingly and disproportionally threatened by men. Perhaps its not surprising that women and girls are less likely to embrace computer technology . . ."

Teachers

Winston Heights Primary School

Towards the end of 1982, Winston Heights placed an order for a Microbee 16 Computer. This situation developed because a number of staff members had been exposed to computers in one form or another, and wanted to apply their knowledge to a school situation.

As a trial, one computer was ordered – obviously not enough for the more than 400 primary pupils at the school, but hopefully enough to allow experimentation and discovery. During 1983 the computer was used extensively in a number of ways.

The Teacher's Assistant

The simplest use was in the role of a teacher's assistant. The computer was loaded with tutorial-type software, designed to teach or practice a certain skill or knowledge. In the team class (as our school is a 'team teaching' school we have a team or double class in each year) this is its main use. In this role the computer is an addition to the classroom, allowing individual work under very direct teacher control. It is also feasible for small groups to work with the computer.

In another classroom, the computer sparked an enormous interest in typing skills; so much so that typewriters appeared from home, or were borrowed and brought along, and an industrious typing school developed. Here the computer was able to supplement skill development with its lighter, more direct keyboard and series of training programs. Needless to say, many children in that class are now competent typists – a fact which allows far greater flexibility and speed when using the computer in other tasks.

In my own classroom, children went through a whole spectrum of activities in order to assist me in a correct analysis of the computer's potential. We started with simple exercises, to develop a knowledge of the computer and show that it really was a machine – not an all-powerful monster as some science fiction would have us believe. Next, we ran through some typing skills, to allow greater ease of use. After that, we spent some time using the computer to assist slower, as well as the more advanced pupils, improve in some areas of maths and language. We asked for, and received, a demonstration of the Wordbee ROM pack and discovered for ourselves the value of the computer as a word manipulator. Many children were impressed with the idea of correcting stories without lengthy rewriting.

Some of us played around with simple programming. It was nice to be able to type your name and have the computer address you personally. I spent some time trying to develop a filing system for pupils' results and grades, which would allow the printing of reports by the computer. This works well enough with my own System 80, as I am more familiar with its version of BASIC, but I have not been as successful converting the Bee to a similar function – as yet!

Simple conversion of a program for spelling has proved interesting. For a short time during Term 1 we played a lot of spelling oriented games. It's amazing how many results improved during that time.

Limited Access Time

One of the major problems we have found is the lack of machinery. One computer, even when restricted to 100 Year 6 pupils, does not go very far! I found many of my own programmes had to cease when other teachers became interested in the computer and its uses. I decided that for the computer programme to be a success in my room, I needed a computer all the time – not just three days each fortnight. To be able to make *full* use of the Wordbee we also needed a printer. Yes, we could use it without, but the full benefits of the program could not be realised.

In summary, then, we have one computer reserved exclusively for the use of Year 6. Since the computer travels on wheels (a modified desk with two wheels and a handle) around its four classrooms each week, none of us have had it long enough for it to lie around unused. I have described our applications briefly above, and I can say with confidence that I think the computer can be used at the discretion of each teacher, or under the control of a school-based policy. Software is one of the major needs. With more and more programs coming onto the market, this problem is reduced

AND NOW, CHILDREN, MAY I INTRODUCE YOUR NEW HEADMASTER... ...PARDON... HEADPERSON... ...PARDON... HEADTHING... ...PARDON... HEAD WHATEVER, ONLY IT DOESN'T HAVE A HEAD...

Told Us

There is a tendency to hypothesise about the benefits of having computers in the classroom, but actually getting the machines installed and functional isn't always easy. Here we've borrowed from the Northern Districts (Sydney) Education Centre's booklet, 'Introducing Microcomputers into Primary Schools', to give an idea of how computers are being introduced into our schools. Published in January, 1984, the booklet deals with the experiences of pioneers in this area of education. Their stories are still being re-enacted in schools throughout Australia.

from one of availability to one of selection.

If your school is interested in buying a computer, and I believe you should be, spend a lot of time looking before you buy. I know of one school which has a computer gathering dust – we, on the other hand, want more. Carefully examine all the machines on offer.

At this stage we don't require colour, nor do we have the money for colour screens. We have no need, yet, for machines with a large memory, nor the requirement to 'talk' with other computers by phone. We do know we would like at least one computer in each room, and possibly one printer to go with them. We also know we need more and better software. I don't want to make any suggestions to you about software suppliers – but be careful and look widely before buying anything!

Our plans for the future do involve computers. They will also involve a very careful assessment of each step in the scheme before more money is outlaid. There can be no more useful aid to 'the three Rs' than computer awareness and involvement. In fact, like decimal currency, they're here to stay – we can make them and the technological approach they represent really work for us!

Another facet of our program in computing has been the number of machines purchased by families at our school. Surely that is an indication of our success.

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Glenfield Public School

Glenfield Primary began its computer program with the purchase of five Microbees and one Apple II in October 1982. The initial step was to have the staff discuss the concepts and practices involved in computer use, then ask the P&C to support the venture, both in concept and in practice, by providing $4000 for the purchase of the hardware and software. At that stage there was only one person on the staff with a little knowledge about computers, so it was a bold venture.

Initially the Apple II went to the Infants Department and the five Microbees went to the primary classes on the basis of one for every two classrooms.

Success was almost instantaneous, especially as pupils enjoyed the challenges presented by the programs, and teachers began to see the scope they offered.

Expertise in Demand

Problems were caused by a lack of power points in classrooms, programs that didn't load and monitors that needed adjusting – so the one member of staff with knowledge was kept busy. The other frustration was that the shared use restricted the children's access to the computer, and because the initial steps had proven so successful it was decided to go further.

The P&C was asked for another two computers early in Term 1 of 1983, and the children were involved in a Computerthon in which they had to answer 50 tables questions on a computer. Parents assisted with supervision, and the children raised over $2200. This enabled the purchase of three more computers and a printer. Other school funds (from concerts, photo commission and so on) enabled the purchase of two more, and then the P&C bought another two – so the school now has 14 Microbees with word processors, and one Apple IIe. Each class from Year 1 to Year 6 has a computer in the classroom.

Each Monday all the computers are set up in the library and classes are taken on rotation to use the word processors. Children sit in pairs, type in their stories, change them, edit them and finally record from the computer onto tape so the work can be printed on the printer. Four copies are made – one for the child to take home, one for the teacher's reference, one for the library so pupils in the school can read it, and one copy to put on display in the classroom. The fact that children can type a story, and the fact that their stories will be read at home and at school provide strong motivation, and results have exceeded our expectations.

The teachers, despite their initial fear of computer technology, have become competent in the use of the machines, and several have begun to write their own programs. The pupils, both the gifted and the remedial, have benefitted from the programs geared to their needs. Children have been very responsible with the machines and many have enjoyed the extra responsibility of setting up and putting away the computer each day.

The success of the total programme at our school depended on the principal's initiation and encouragement of the plan, the support of the parents, the co-operation and dedication of the staff and the wide-eyed enthusiasm of the pupils. We're glad we began it when we did.

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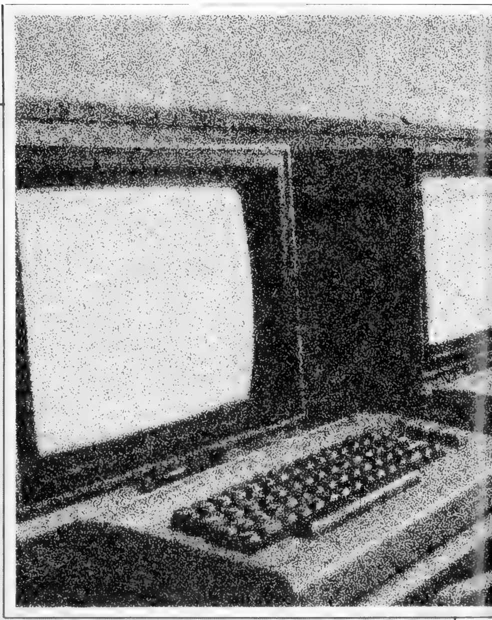
Teachers Told Us



Gulgong High School

I began this year with twelve Year 7 students – all with problems in reading, language and maths. I took all periods in English, maths and social science, and shared their science periods with another teacher.

Early in the year the school acquired five Microbees, three of which have been generally available to me to use with my class. However, being situated in an isolated country high school, information and support service ranged from minimal to absolutely none. What to do with the computers and how to do it were problems for us to sort out on our own.

Once I'd got over the initial trauma of learning how to put them together and how to run the available programs, I was able to put the computers to good use, despite difficulties of location – the machines were housed upstairs in the library, away from my classroom. Being located a few minutes away from the machines meant I could only load new programs at lunchtime or in my off periods. The school may acquire networking facilities which will relieve this problem, but the better alternative at present is to have students trained and responsible to load the required tapes.

Nothing Succeeds Like ...

The programs I received at first were very limited, but for children used to failure I have found them highly motivational and a sure way of their experiencing success. Children who are twelve and have not mastered basic operations in maths or to whom spelling remains a complete mystery will happily practise these skills on the computer, and for longer periods of time than for any other set work.

Maths and spelling are the two areas in which computers have been most useful for my class, though I look forward to utilising reading and language programs as they come to hand.

I find that while part of the class is working at the computers, I am able to give more individual attention to the rest. At the end of some periods and at lunchtime the computers are used for simulation and other games – which of course are very popular.

Until now, I would regard my efforts as a learning experience for myself as much as for my class, and already I can see great possibilities in both group and individual work for children who have failed so consistently under other methods.

The school is going to acquire more computers, so I will be able to use up to ten. With these and additional software, next year should have a bigger story to tell. Meanwhile, I'm glad I've persevered to this stage to be able to make positive plans for children who so badly need a confidence booster.

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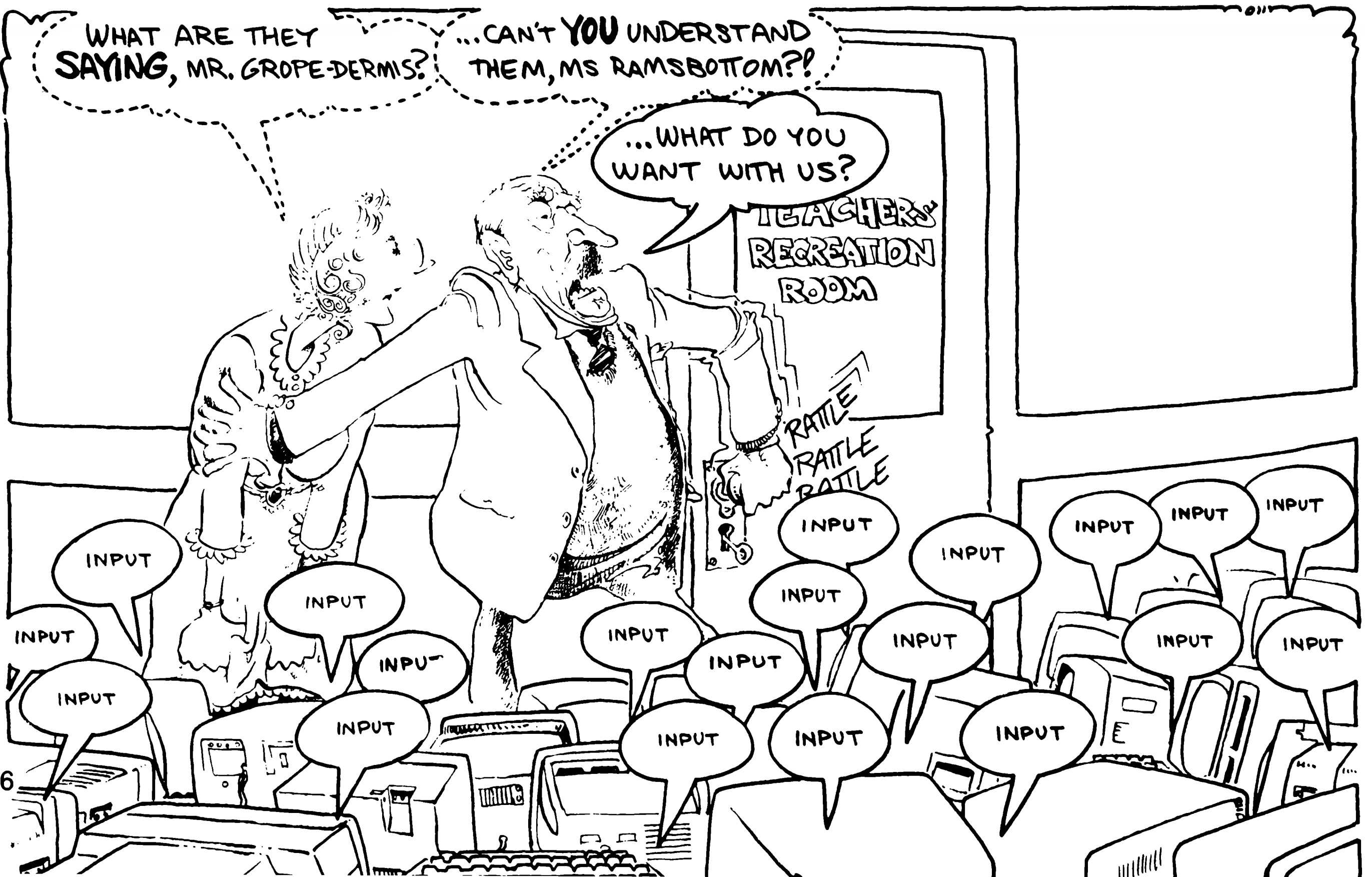
WHAT ARE THEY SAYING, MR. GROPE-DERMIS?
...CAN'T YOU UNDERSTAND THEM, MS RAMSBOTTOM??
...WHAT DO YOU WANT WITH US?
TEACHERS' RECREATION ROOM
RATTLE RATTLE RATTLE
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Woodberry Primary School - Hunter Region

In July, 1982, the first microcomputer at our school was being used in a Year 3 classroom. It was borrowed on a day-to-day basis from a local TAFE college. This led to the generation of interest from other teachers and the senior executive at the school.

Within eight weeks of this first exposure to computer education, orders had been placed for our own machines, and detailed submissions were prepared for Disadvantaged Schools' Funding. A large amount of the energy supporting computer education came from the Parents and Citizens Association. This energy was translated into financial support in the form of 50 per cent funding on the first six computer units in the school (approximately $1300).

Teacher Training

At the end of 1982 we had one staff member with a working knowledge of computers. By encouraging other teachers to undertake a six-month (three hours a week) training course at the local TAFE college (Maitland), and providing after-school, unfunded inservice training, we now have five very experienced teachers and three staff with a working knowledge of machines within the classroom. It must be noted that very little encouragement was required for staff to attend the 18-week technical college course – teachers are very apt to see and interpret the future of our society.

In the second week of 1983 we began a computer studies course for all Year 6 children. For 60 minutes each week of the year, each child covered a course to introduce them to computer usage in society. Domestic, business, manufacturing and leisure computer applications were covered with each of the three Year 6 classes.

An understanding of how computers and robots operate was developed by teaching the children about the BASIC programming language. The intent is not to teach the children to become computer programmers, but to help them understand how simple and complex computer operations can be. The fallibility of computer software is also well illustrated by this approach. This instruction in a programming language has been carried over into the home and community, and has been instrumental in developing computer awareness in our local area. The ABC-TV broadcasts for schools on computers have been very beneficial as a teaching aid.

Present And Immediate Future

At the end of 1983 we had one machine in each of the three Year 6 and three Year 4 classrooms, and one in the composite OA class. At the beginning of 1984 we aimed to cover Year 5 and have a computer in the library. We decided not to have much computer language instruction in the Computer Awareness Curriculum for Years 4 and 5. This was reserved for Year 6 classes. Each curriculum is evaluated on a trial-and-error basis.

We included the Infants Department in the computer awareness programme before the end of Term II in 1984.

Robotics is also a vast field of untapped technological advantage and suspicion (almost superstition), and is a direct result of micro-chip technology. It needs to be given a prominent part in any computer awareness course. We have less than six years before robots will play a major role in domestic and office activities. We are endeavouring to prepare children and parents for a gradual but massive change. Schools can't alter the course of technology, but we may lessen the impact.

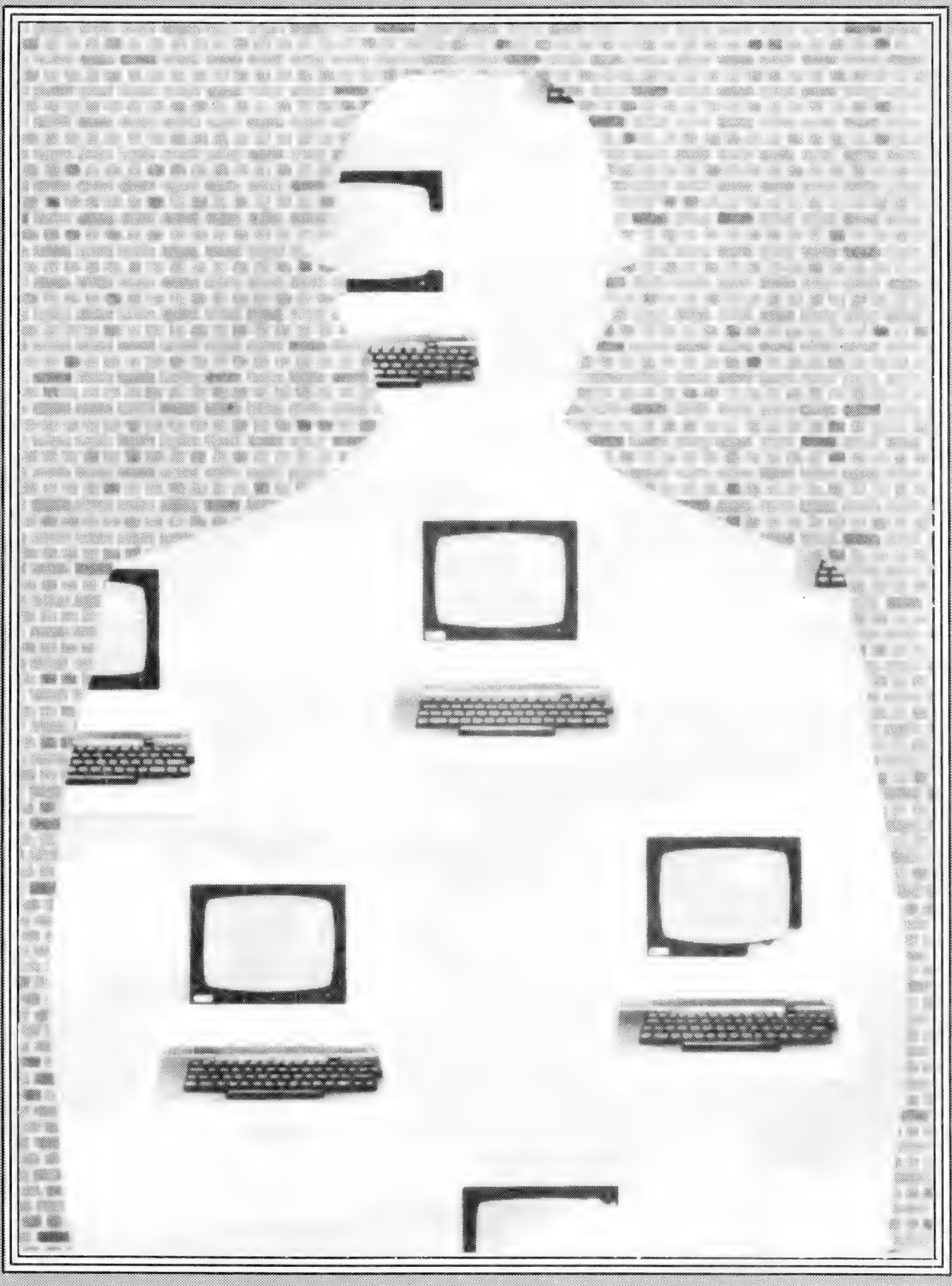
Aspiring to a Mainframe

By the time of the national bicentenary we will have a mainframe computer system with at least one or two terminals in each classroom. All school management decisions will be aided by the main computer. Accounting, record keeping and classroom-based child-data collection will be managed by the main computer. Individualised curriculums will be used by teachers for all children, and each teacher will be aided by the computer in classroom management decisions. Microcomputers will be available to all children on a ratio of about five to one. Teacher effectiveness will have increased by about 20 per cent.

We have approximately 750 children in the school at present. Is our forecast a dream? No, it has been a reality in most large to medium businesses for over five years already. Automation will not be restricted to private business alone, it will be forced on us by financial, managerial and community pressures. As a pilot school we intend to chart the waters ahead so others may follow with confidence and security in the goals of education. ■

'Introducing Microcomputers into Primary Schools' is available for $3.75 (post paid) from the Northern Districts Education Centre, Corner Beecroft Road and The Promenade, Cheltenham 2119. The centre has also produced a second booklet, 'Part of the Furniture', which relates, again in case study form, the experiences of teachers who have progressed beyond the initial stages of computer education. This publication may be obtained from the same address for the post-paid price of $4.25. For more information, phone (02) 868 1533.

NETWORKING



Reproduced with the kind permission of Barson Computers.

If you've progressed from the 'one school, one computer' situation, you might like to look at the possibility of sharing a printer or disk drive between the machines, or of 'broadcasting' programs to a number of student cassette recorders. Frank Lee takes a look at how networking can help schools spread their limited resources.

in the School

Networking is a means for sharing information and/or limited resources (like a printer or a disk drive) between two or more user 'stations'. It is achieved through a combination of hardware and software. The fun comes in working out whether the added expense invested in that hardware and software can be justified by the ability to share.

There is a technical but fairly simple jargon associated with networks. All you really need to know is that a network consists of a collection of *nodes* (user stations) which can communicate with each other, or with a *master* node over *communications channels*. The communication mode is digital. There is no need for each node to be linked to every other node by a direct route, since nodes may be able to pass on messages to adjacent nodes. The term *topology* is used to describe the node-to-node connections. For example a *ring* topology consists of a set of nodes, each one hooked up to its two closest neighbours to form a closed ring.

The Broadcast System

Let's begin with the simplest possible network arrangement – the broadcast system. Broadcasting gets its name from the way in which radio stations broadcast their signals. Apart from telephone call-in sessions, radio stations broadcast their information in a single direction: from their antenna to the thousands of your antennae. It needs no fancy communications protocols or timing considerations. The information goes from a single source to multiple destinations.

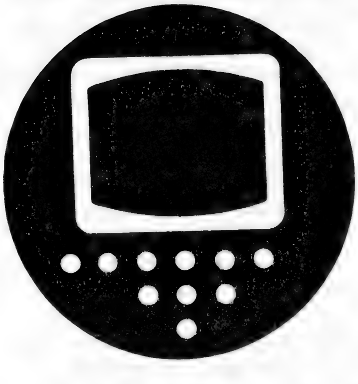
Similarly, a bunch of school microcomputers can take the place of the radio receivers, each 'listening' to a selected 'radio' channel in order to receive the desired program information.

Here's a broadcasting scenario to consider: A school is endowed with a number of cassette-based microcomputer systems, all of the same make. The students are to be given access to a range of computer programs which would normally be supplied on cassette. Instead of spending money on individual cassette recorders, one for each micro, we hook each micro's cassette port to a cable which wanders around the entire school. At the 'transmitter' end of the cable is a powerful amplifier, which is pumping each of the required programs in a repeated cycle. This transmitter sends a signal exactly like the one generated by the cassette player. By this means, each micro has access to all programs in the cycle. The catch is that one must add a small level of sophistication to each micro so it knows when the required program is actually being transmitted.

The catch is not really an obstacle. Many microcomputers already allow for cassettes to hold multiple programs, each preceded by an identifying header.

A more serious catch is the time elapsed between each replay of a program in the cycle of transmissions. If the transmission is at 1200 bits per second (a reasonable assumption), then an average 8K program would take 68 seconds to load. If the cycle involved 20 such programs (a not unreasonable expectation), the cycle time would exceed 22 minutes. In other words, if the student wanted a particular program, and hooked into the broadcast just after his program started its transmission, it would be necessary to wait another 22 minutes in order to catch the program header again – hardly a proposition.

A solution to this kind of network problem is to lay a cable with multiple conductors, one for each program. At 1200 bits per second, the cycle time would then be a minute or so. But you have just

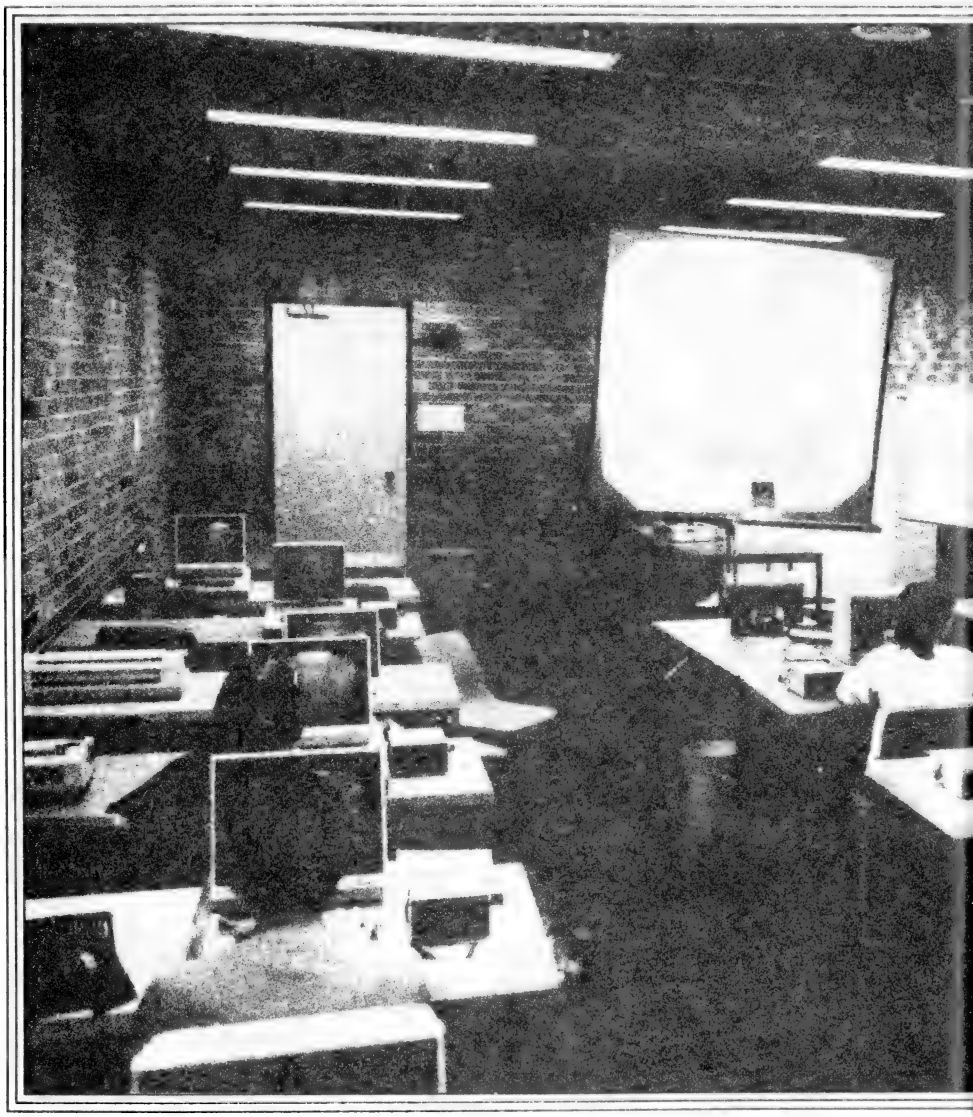


upped the cost of the exercise by using an expensive cable, and much more expensive transmission equipment. Each user node would need to be equipped with a line-selection switch or patch board.

Again, one could up the bit rate on the cable from 1200 to (say) 9600 bits per second, or even higher. On a broadcast network, such an arrangement is quite feasible since it is not constrained by the limitations of audio cassette recordings. However, it would be necessary to make some circuit changes to each of the micro cassette ports in order for them to be able to cope with the increased speed.

A Sponsored FM transmitter

In the same vein, the same kind of digital broadcasting could be offered by a sponsored FM transmitter. In that case, each micro would be hooked to an inexpensive FM receiver. The catch is, that without some form of (expensive) multiplexing, we are back to the one-wire cycling system. Nevertheless, just this kind of digital transmission has been used for some years in Europe. Of course, in the special case where an instructor has control of both the ▷



class and the transmission system, programs may be transmitted as they are needed on a single channel. to the remote class over the same channel.

An example of a closed broadcast system is the network of Tandy computers at Sydney's Power House Museum, where the cassette ports of all the machines are hooked back to a single cassette player under the instructor's control.

Local broadcast networks represent the simplest possible approach to networking. What's missing is the ability for the student to interact with the remote transmitter. The problem is that once we start to add a reverse line to the system, networking becomes a more complex procedure.

Local Area Networking

Most schools will be concerned with some sort of *Local Area Network* (LAN), as distinct from a *Wide Area Network* (WAN) which is forced to make use of Telecom's communications facilities. WANs are normally required when schools decide to cooperate in joint networking (and therefore resource sharing) exercises. The Elizabeth Computer Centre's Tasnet is a WAN servicing Tasmanian schools. Modems are used to interface the schools computing equipment to the telephone system.

The rules of the game are that we are not permitted to transmit data across a public road without appropriate Telecom or Radio Authority permission. Although most schools are contained wholly within a set of public roads, unfortunately some Australian universities have campuses split by major roads (for example, Sydney University is now cut by City Road).

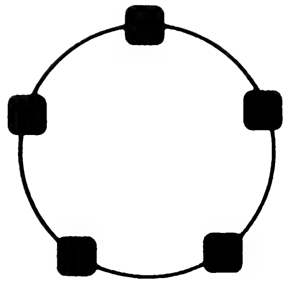
If it is possible to use a LAN, the normal Telecom limitations on the kind of allowed communications technology no longer apply. You can design your own, or use an appropriate imported technology.

The Right Network for the Course

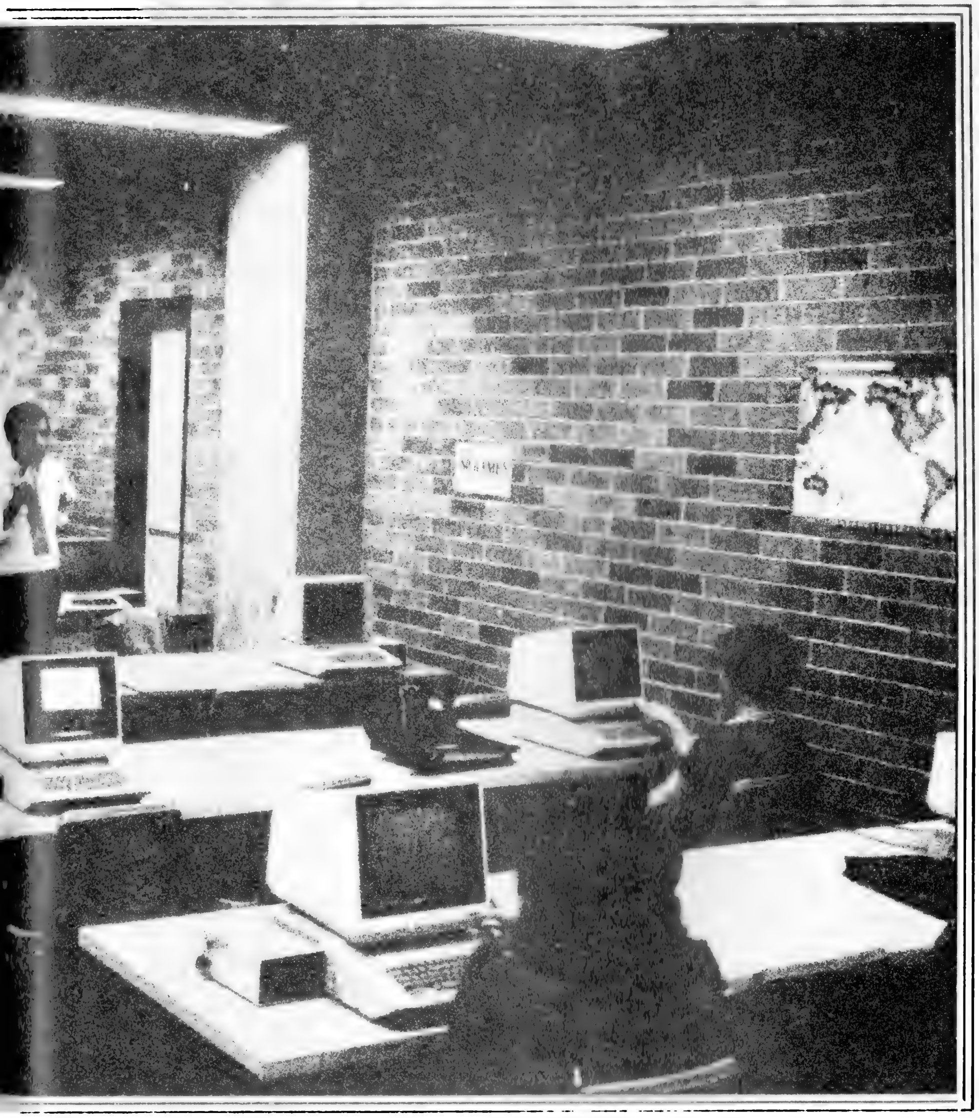
But before diving into complex LAN technology, there is still a great deal which enterprising schools can do for themselves. The important consideration is that one must first determine just how the network will be used in a teaching environment. It must be the demands of the course (or courses) which determine the technology, not vice versa.

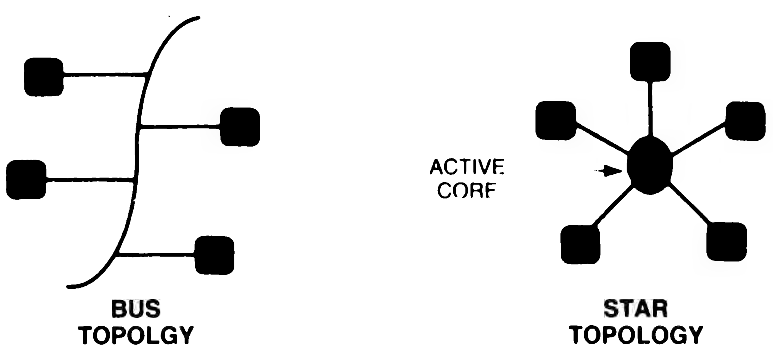
An example of such enterprise is the BASIC Computing Lab used by the School of Accountancy at the University of New South Wales, where a *star* network with six terminals is being used to teach Introductory BASIC to first year students. Though the student numbers have run as high as 1000, and each student needs six hours in the laboratory, these six *dumb* terminals have been able to cope easily with the load.

Here's how it was done. The teachers began by designing an audio-visual course consisting of film strips and associated cassette tapes. They also prepared a workbook, and linked the course to an established textbook and a set of BASIC programs. They then set up a 'learning laboratory' with 16 student 'carrels'. Each carrel was equipped with a simple film strip projector and a cassette player with headphones. At the rear of the room were set six dumb terminals which hooked into the school's PDP-11/40 computer. The PDP-11 provided a timeshared BASIC facility, as well as a number of read-only programs which students



RING TOPOLOGY





were expected to debug, or to complete, or whatever.

Because of the short duration of the course there was no need for students to have the ability to save programs. This latter point had a profound impact.

Indeed, if you can dispense with the need to store half-baked student programs, then the next step becomes possible.

A Star Network

After some years of grumbling about the reliability of the PDP-11 (it had a yen to go to sleep halfway through a laboratory), it was decided to replace the timesharing system (so far as the lab was concerned) with a Z80! That's right, a single microprocessor servicing six user terminals, each running at 9600 bits per second.

Can't be done? Don't believe it. It's been working since 1980. The accountancy gurus built up a modified Xitan S100 system with its Z80A microprocessor, 48K of ROM, 16K of RAM and a six-port serial input/output board to hook to the six terminals. They wrote their own timesharing operating system (chewing up a whole 2K of the ROM), their own BASIC interpreter (another 8K of ROM) and planted the entire library of instructional BASIC programs in the remaining ROM space. The 16K of RAM was divided equally among the users currently logged into the system.

A system like this is called a 'star' network because it has a servicing hub connected to the user terminals on 'spokes', rather like a star burst.

It is questionable whether such an approach today would justify the effort. This is because a simple microcomputer with built-in BASIC may actually cost less than a commercial dumb terminal. If there is any saving, it is in the ability to share the resource of the ROM-based library without having to wait while the programs are being loaded.

Sharing Hardware and Software

Other network systems let you share hardware resources as well as software. Quite often students need to take a hard copy of results, or a program listing. Rarely, however, would a student require a printer full time. Accordingly, it makes sense to share one printer among (say) a dozen or so users, on a first-come first-served basis. If the hub of the star network (or some other dedicated node) is equipped with the printer, it is possible, by means of appropriate software, to organise queues of files awaiting printing.

A simple system capable of such printer sharing has been installed at Hunter's Hill High school. Using a *multiplexer* designed by a Sydney couple, a single Apple II or Microbee acts as a file server for up to ten Microbees. The file-server micro is under the teacher's control. A number of options are available. The teacher can *download* programs to the *slave* micros in a broadcast mode at nearly 2000 characters per second (19.2 Kbaud). Students may also *upload* programs to be saved on the ▷

These Apple IIc computers have their own disk drives, but to allow children to get 'hard copy' of their work, the machines could be networked to share a printer.

file server's disk. In addition, a printer hooked up to the file server may be shared by the slaves on a first-come, first-served basis. The multiplexer itself has one input (for the master) and ten outputs (for the slaves). A simple byte-by-byte protocol using a hardware handshake method ensures that none of the slaves get data indigestion by being fed faster than they can consume. It is also possible to increase the number of slaves by *treeing* the network. To do this, you simply install a second multiplexer in place of a slave. This leaves nine slaves on the original multiplexer, but allows for an additional ten on the second. In theory, such treeing could proceed indefinitely.

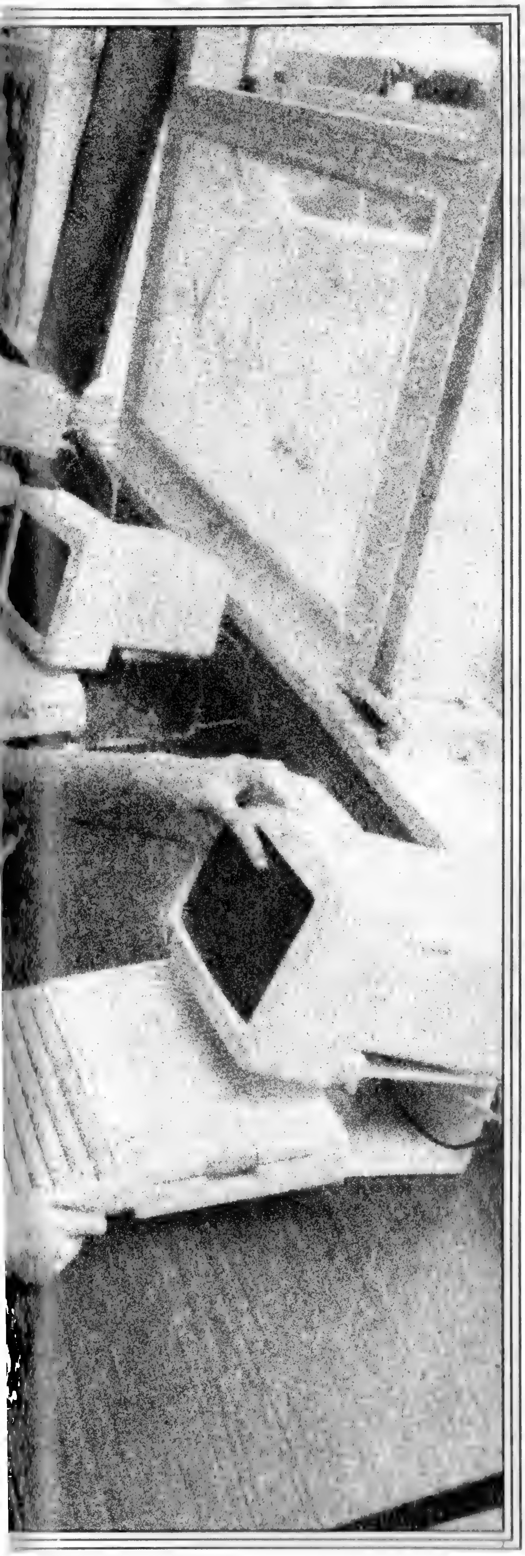
Where All Terminals Are Equal

In the commercial world, one of the primary uses for networking is the sharing of electronic mail. The master-slave form of network is less appropriate in that environment. The commercial systems are more egalitarian.

An example of such a commercial system is Xerox's Ethernet, a coaxial-cable-based system which offers high-speed resource sharing among a large number of users. Actually, Ethernet is a particular form of technology known as CSMA/CD (Carrier Sense Multiple Access/Collision Detect). A locally distributed version known as XNET (available through President Computers in the Sydney suburb of Hornsby) supports a network of up to 255 IBM-PCs (or workalikes) for around $750 per node, plus the cost of cabling. A similar system (known as the Web) is available for Kaypro users. Because CSMA/CD systems can use very high-frequency radio carrier waves, the rate at which data is transmitted through the network is measured in millions of bits per second.

A particular advantage of master/slave systems is the degree of control which the teacher has over the network. Furthermore, the hardware requirements are generally far less expensive than systems like XNET or Ethernet. In particular, one can afford slower communications rates. This means cheaper hardware and less expensive cabling. Consider, for example, the possibility of using a (legal) low-powered FM transmitter in a classroom. Each micro in the room could be fitted with a simple solid-state FM receiver circuit preset to the transmitter's frequency. A similar system can be achieved using infra-red techniques like that used by IBM for the keyboard on the PCjr. On the other hand, if the micros are 'nailed down' to the desks, why not use simple twisted wire pairs for the lines? A twisted pair can run at 19.2 Kbaud with ease over many metres.

Another advantage of the master/



slave arrangement is that there is less concern over the possibility of one user corrupting the files of another. Files on the master node can be *ad-only* as far as the slave nodes are concerned. In other words, a slave can only download system files from the master. Files which can be uploaded can never overwrite system files.

What's Available

Among commercially available networking systems suitable for schools are StarNet (for the Microbee), Apple's Omninet, the Commodore VicSwitch (for VIC 20s) and Multi-link for the Commodore 64.

Multi-link was designed by Cybex Computing, a South Australian company. It supports up to 48 Commodore 64s in a single network. The network is controlled by a master terminal as a file server. This means the slave units do not need to have their own disk drives. Slave units simply download required files from the file server on a high-speed communication line. The master station can also read the text and contents of any other screen, and can be used to transmit and receive messages, as well as to control student access to the printer. An entire system composed of eight slave computers would cost around $2500, including the Commodores, disk drive, and printer.

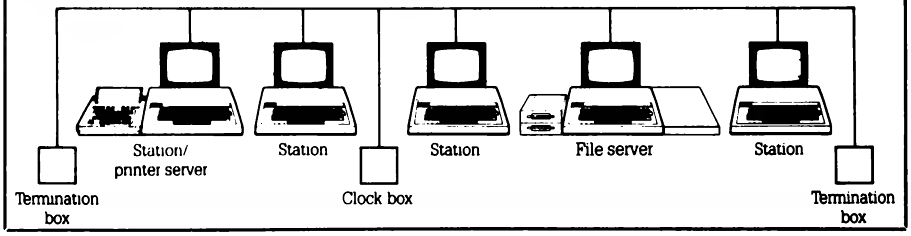
The BBC microcomputer networking system is similar to Cybex's Multi-link. A $225 kit is available from Barson to add a networking port to an existing BBC micro, or the micro may be ordered with the port installed. The port consists of an RS423 serial channel which may communicate over a dual twisted-pair line costing around $1.40 per metre. One or more of the computers on the network is designated as a file server. Another may play the role of printer server. With a 'level one' system (the cheapest), the file server (the master) should be a BBC with an 800K disk drive, a monochrome screen and appropriate software. A clock terminator unit is also required, to implant a synchronising signal on the lines. A level one system can safely accommodate up to 15 nodes (slaves). Moving to level two increases the number of potential nodes, and adds a considerable degree of sophistication to the system. In particular, the level two master is equipped with a second 6502 microprocessor dedicated to network control. It can also handle a hard disk instead of the floppy. Moving to level two costs an additional $500.

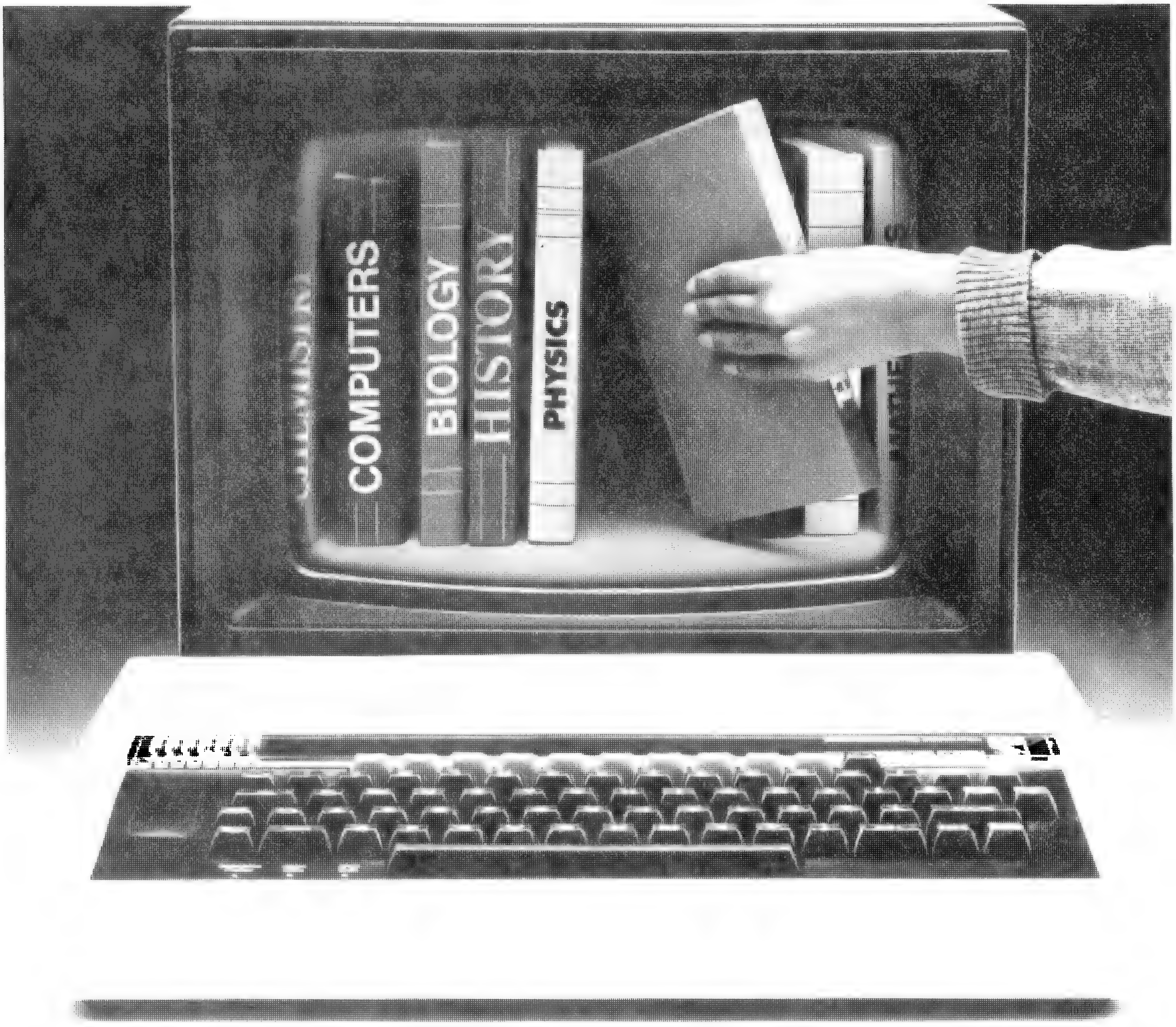
The BBC printer server is simply another BBC with an additional printer server ROM chip (plus, of course, the printer).

Apart from the ability to download and upload programs, the BBC network supports message switching and the monitoring of slave operations.

The ability to offer a strong master/slave classroom network is a major factor to consider when selecting a microcomputer for a school. You must also be certain that the network has adequate software support. In particular, since it will be used by some teachers who are wary of computers, it should offer simple menu-oriented command modes for the master terminal. A help facility is useful, and the documentation should cover the needs of the naive computer user through to the needs of the people who will be responsible for maintaining and developing the network in the future. ■

The BBC computer networking system, Econet, allows students at terminals to communicate with the teacher at a master terminal, and vice versa. It also facilitates sharing of resources like printers and disk drives.





Good students can learn anything. As long as they know their BBC.

Obviously, every student lucky enough to have access to a BBC computer is going to learn about computers.

But that is not the only subject they will have at their fingertips.

For the BBC school computer can enhance virtually any subject on the school curriculum.

Hundreds of educational programmes have been written for the BBC by educators in the U.K.

This material, which is of a singularly high standard, was prepared to achieve a major British Government policy objective of computer literacy in schools.

In addition, a number of State Education Departments in Australia have written a range of curriculum specific software to plug any cultural gaps.

To simplify the learning process (not to mention the teaching process) the BBC system allows each student in the class to progress at his or her own pace.

Unlike the traditional classroom, no one is held back by the other students or, conversely, left behind.

Even the language of the computer, BBC Basic, is easier to operate so students can begin computer programming much earlier.

In short, the BBC is the computer for learning.

And once again, the British Broadcasting Corporation has helped make the learning process a pleasure.

The BBC school computer.

For more information on the BBC microcomputer and the new compact version, the Electron, send this coupon to:
Barson Computers Pty. Ltd.
335 Johnston St., Abbotsford, Victoria 3067, or 7 West St., North Sydney 2060.
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BARSON COMPUTERS

COMPUTER Administration FOR SCHOOLS

Keeping the full management records for a school is a business-like operation, so choosing a computer to handle such tasks involves different considerations to those which apply to buying a classroom computer. Norman Kemp, business writer for 'Your Computer' magazine, outlines a buying strategy.

When considering a computer system to handle school administration, detailed planning is required to ensure that the cost, which represents a heavy investment of school funds, can be spread over a long term, with the maximum benefits being obtained over a period of at least five to seven years. An attractive cut-price offer of a small microcomputer will not turn out to be an economical purchase if it has to be replaced in two or three years because it has run out of capacity to handle the routine administrative tasks. The investment may be lost, not only in the hardware, but also in the software purchased at the time, which might not run on another machine.

The rapid changes in computer technology over the past couple of years have led to the introduction of a new class of 'supermicrocomputers', which covers the ground between the lightweight personal computer and the complex and more expensive minicomputer. Computers in the supermicro class are fast in operation, have considerably larger internal memories and disk storage capacities than models of as little as twelve months ago, and because of their increased performance tend to have better and more professional software written for them. The more advanced models can permit several users to work on different tasks and share ▷

terminals or printers simultaneously with little degradation of power. The decision to purchase a computer of this type cannot be made solely on grounds of cost; compared with a single, standalone classroom machine it may be three or four times more expensive as an up-front cost, but if amortised over about three years its value is proportionally higher.

Multitasking and multiuser, two popular words in the business computer language, are equally relevant to the jobs a computer may be expected to do in the educational environment – but they also have to be paid for in the installation.

Even though computers have been available for general business uses for about a decade, it is still a common fault for many purchasers to underestimate their needs, and buy equipment that is too small for their purposes. Schools should not fall into the same trap. Businesses often develop in a haphazard manner, and their objectives may not be clearly defined when they start calling up computer vendors for quotes. But the institutional needs of schools are traditional, and, with the possible exception of specialised classroom teaching, can be planned with reasonable accuracy in a well-run organisation.

Involving the Staff

When buying a computer for school administration, consultation between principals and teachers at an early stage is essential. They should aim to formulate a long-range plan so the computer can be brought in initially for the essential tasks, and then extended to meet the various desires and wishes of individual staff members. The plan should include a program for training teachers to use computers, so that as each person gains confidence they can work out the manner in which the computer will assist them in their jobs. This training does not need to be carried out on the computer under consideration.

It has been noted at a number of schools that while educators are reasonably amenable to using computers to teach pupils, they are suspicious of using computers where the machine may appear to be taking away part of their responsibilities or decisions; say, in the formulation of lessons or allocation of time to classroom duties, which they have been accustomed to handling personally. Such fears, which have their counterpart in the office world, should be discussed beforehand and each teacher should be given a role in the development of the computer programs which will affect their activities.

Timetabling is one task which a computer can handle admirably, but which may arouse resentment among teachers if they are not consulted in the preliminary stages. Drawing up routines for different classes, ensuring that teachers are available when required, while allowing time off for study or other activities, and organising schedules to enable all syllabuses to be covered adequately within the overall framework of school hours, can consume volumes of paper and many hours of time when done manually.

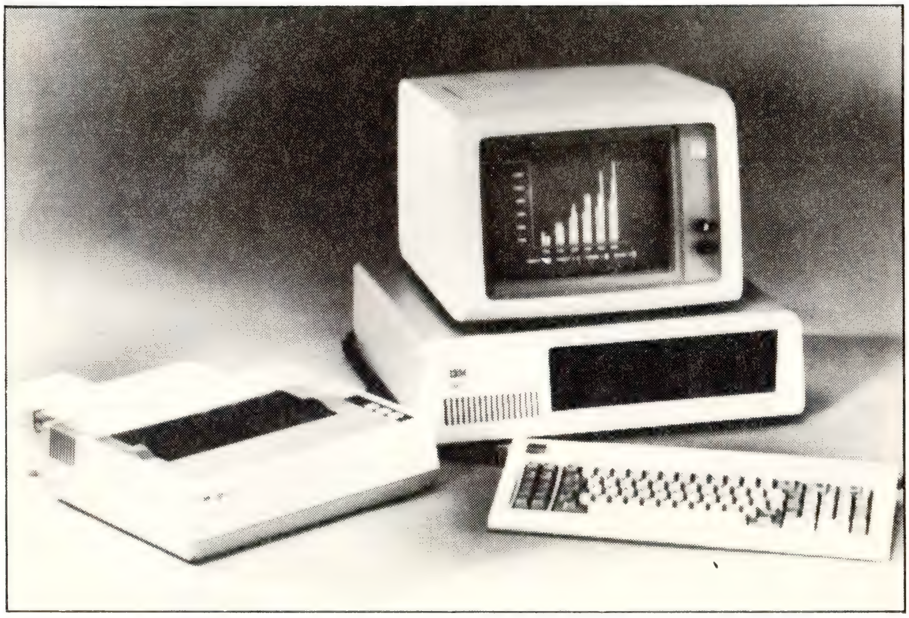
Computer programs have been written which simplify this work, but the personal element should not be overlooked just for the sake of saving time. A manual draft of a proposed timetable can go far in maintaining harmony, and can facilitate agreement on difficult questions which inevitably arise during crowded periods between teaching and preparing new lessons for another class. The computer can be used to prepare subsequent drafts, or rapidly display changes that seem necessary for smooth organisation, with greater chance of harmonious acceptance by the various staff levels.

What to Computerise?

At a recent seminar in Sydney, Colin Woodley, director of the Association of Independent Schools' education services, advised an audience comprising principals, bursars and secretaries to start their evaluation of a school management system by determining those facets of the school's operations for which they wished to use computers.

He counselled that each should be placed in order of priority according to individual school policies and philosophies, and an overall plan should be developed. In addition to the range of activities required for internal management and operations, Woodley said school computer systems may also speed the collection of pupil fees, increase either the rate of collection or amount of revenue obtained from fund-raising activities, and simplify the work required for the production of reports to governments.

He added that it is not necessary for all the functions of computer programs to be integrated for these tasks; there are advantages in starting with a few separate projects, and then building and moving on to



One of the medium-priced machines to consider for school administration is the IBM-PC. A large range of suitable business software is available for it, and we believe the parent company is quite solid (!).

new areas with further programs designed to achieve the maximum benefit from each application.

The Same Salaries, But Greater Efficiency

Woodley said the majority of businesses, other than those such as banking and insurance, did not make substantial savings on staff by using computers. For that reason most decisions to implement computers are made on the basis of other factors, such as the desire to improve the quality of work produced, or to save time. He believes most school management systems are chosen for similar reasons. "The decision has to be practical and hard-headed", he said. "In my view, the nature of school business activities is suited to the application of computers, but schools should conduct a feasibility study so they can prove the need on paper."

Woodley listed a number of areas suited to computerisation: a school system could handle fee collection, debtors, creditors, general ledger, staff and student records, enrolments, fund raising, reporting to the Schools' Commission, payroll, asset register, simulations of the school as a business, word processing, examination assessments, library records and teacher and classroom scheduling.

Although this list was given with private institutions in mind, most state schools are likely to have similar reporting and record-keeping requirements for their management. Keeping track of teacher and parent organisation meetings and committee rolls could be an added function for computerised administration systems in public schools, particularly in recording the raising of funds and allocation of money for school purposes.

An Apple or a Watermelon?

John Treloar, New South Wales Education Commission consultant for the Liverpool region (located to the west of Sydney and one of the most heavily populated areas within the metropolitan boundary), advises a number of schools where computers have been installed for regular classroom teaching. Among them are high schools at Minto, Punchbowl and Castle Hill, and Bringelly primary school.

He says, "Computers can give teachers more time for other activities, but where there are machines in the classrooms one or more should be used to work out the overall administration needs before a school commits itself to the expense of a management system.

"Some state schools," he continued, "do not need very complicated systems, but they should all keep records on their pupils' progress in learning, from the day they enter school. In some instances an Apple II might be large enough for simple purposes, but if a school adopts a business approach it will have to look at larger computers. This automatically means more expense, and could be beyond the budgets of smaller schools who will just have to make the best use they can of any existing equipment."

A Shortlist

A feasibility study on whether to install computers for administration purposes should include a shortlist of at least three computer vendors who can supply school systems. The potential contenders for this list are increasing monthly, since many of the large commercial computer companies have 'discovered' schools as a vertical market and are trying to trim their prices and provide packages to suit educational budgets.

Currently, Burroughs, Wang, Sigma Data and IBM are among the companies with larger-scale systems which can accommodate school management needs, but at starting prices of around $15,000 their market is likely to be limited to the largest and wealthiest institutions.

John Baxter, educational sales consultant for Burroughs Australia, in Sydney, claims economical systems can be purchased by schools with around 500 pupils. He has sold B20 desktop computers, and lately the company's most recent B25 models, in Melbourne, Adelaide, and Rockhampton, with a software module for fee management, and scheduling of classes, rooms and teachers.

Burroughs B-20 computers have been installed to handle administration in some large schools. For most, however, the price of such machines is prohibitive.

He says, "The room scheduling can be a really tough job. The school also has to plot which courses teachers are going to give and the students who will take them. It has to keep records of students upgraded to another form and then plot the classes they will attend. Other details may include student history, previous schools attended and absentee reporting."

A Burroughs B25 installation is also planned for an extensive network at the Canberra College of Advanced Education, which will use ▷

Computer Administration

it for administration and library services, as well as classroom teaching and communications.

At Bathurst, New South Wales, the Mitchell College of Advanced Education is evaluating computer management systems for use over the next three or four years. The College has a Hewlett-Packard 3000 series machine in general use for administration purposes, as well as a Facom M150 mainframe for the academic fraternity, and a campus local area networking (LAN) system. But it is aiming at rationalising a high proportion of eight-bit and a couple of recently-acquired 16-bit microcomputers for future needs. A Fox 2010 microcomputer with ten megabytes of hard disk capacity and a Lotus 1-2-3 spreadsheet package from President Office Machines, of Hornsby, New South Wales, are being used for a range of evaluations, particularly as the college is planning to standardise on IBM-PC and compatible equipment. Future projects will include word processing and other office automation applications.

Hard and Soft at Once

The computer hardware and software for a school management system should be planned together, though this is not always an easy task if different suppliers are involved and the equipment is larger than the usual classroom-micro size. A working demonstration of software on the brand of computer proposed for the project should be arranged, to allay any fears about incompatibility of systems, or about whether it has the capacity for the job.

It is important to ensure that some provision has been made for upgrading both the hardware and software. For this reason it may be better to purchase a computer which has a track record of a year or two behind it, from a well-known company that can continue with support and back-up. Blinding new technological marvels have been known to phase out unexpectedly if sales fall short of expectations, or – as has happened on several occasions – the parent company runs short of finance and has to suspend operations.

Also important is the question of how many companies are writing software for the machine. A notable number of computers which perform well technically are significantly short of software, or have packages available only from the vendor at a price well above market average for similar products. In many instances changing computer brands at a later date can lead to the loss of all the software acquired for the original machine.

Get Them to Come to You

Asking several suppliers to tender for a school system, and then putting their products through their paces before committing to a purchase, gives the fairest idea of the capabilities of the computers and the relevant software. Ordering on the basis of being able to use the facility of preferred suppliers, or under the umbrella clauses of an existing contract approved for another department, may be an easier way to move within the constraints of educational institutions – but it can limit the choice of equipment and shut out the claims of other suppliers who could be worth consideration.

Choosing an administration system requires the meticulous planning of a business; the use of other computer facilities, if they exist, to map out a general plan of the information the school will need and what reports it should produce; and the full co-operation of all members of the teaching and administrative staff in the overall design and implementation of the system.

Looking at Software

There are three main categories of software which concern the buyer of a school admin system:

1. The operating system, which does the program handling, or housekeeping, for the computer. This is usually sold with the computer hardware as a standard component; CP/M and MS-DOS are examples.
2. Applications programs, such as spreadsheets and accounting packages, which may be implemented with only minor modification to suit individual needs.
3. Custom-tailored packages, which are specially written and, for that reason, are generally rather expensive and beyond most school budgets.

For many purposes, a database system to manage large amounts of varied information is essential. Though it may appear complicated to operate at first, it can store and retrieve files, indexes and other records very quickly, and can save a considerable amount of entering and filing under other separate systems. Most current computers are built with sufficient memory to handle even the largest of these programs. The minimum requirement would be 128K of random access memory (RAM), and dual floppy disks with not less than 360K storage – a

The Sydney College of Advanced Education has used an HP3000 Series 44 computer system to handle administration since 1982. For such a sizable institution the installation is necessarily large and requires five people to maintain and

number of machines exceed this comfortably. An alternative configuration would incorporate one floppy disk and a fixed, or 'hard', disk with a capacity of not less than ten megabytes.

Two Examples

The number of companies which have written software specifically for schools administration is relatively small. Their products often apply to a particular area or educational institution, and would require considerable modification for general application.

Bruce Stockdale, a qualified accountant who started his career in the Victorian Education Department's accounting division, is one of a few specialists in management information for schools who has a practical background in the field. He is now commercial and educational sales manager of a Victorian company, MOS Microcomputers, of Glenhuntly, which has developed a relational database named Pearl School Administration Package.

Pearl School was based on a well-known business database and information management product from the United States, Personal Pearl, and is used on a number of eight-bit computers (a 16-bit version is being prepared). In a relational database, data contained in all files can be linked for the production of informative reports; it is not necessary to enter and repeat large volumes of information if there is a single link between the two sets of data.

"The need to update management information systems in schools has been apparent for some time," said Stockdale. "What was necessary was the advent of the microcomputer, and its development into a reliable, low cost and easy to use piece of equipment. Also necessary was the development of a suitable software package, again at low cost. Pearl School was developed as a basic administrative information system which may be put to immediate use in reducing costly overheads. Time spent in manual recording methods can now be efficiently utilised in data analysis and improved management."

The principal areas which Pearl School can handle are: general accounting, holding up to 10,000 ledger accounts; salaries and wages, including production of pay advice slips, payroll summaries and group tax certificates; staff demographics, for producing lists and other details concerning staff; the asset register, including relevant details for insurance and general management such as stocktaking; and student records, which can be listed either demographically or according to academic achievements. Among the extra units under development are an emergency teacher selection system, for replacement of absent staff; a student accounts unit, mainly for private schools; and a library cataloguing and cross-reference system.

program it. The system components include the main processor, three disk drives, three printers and ten terminals (five of which have inbuilt thermal printers).

Outside the administration block, a library system may be the next largest requirement for a school. As with business systems, allowance should be made for growth and extensions to library services.

Lothlorien Software, of Sydney, has developed a library management system which uses a 20 megabyte hard disk to handle approximately 60,000 items, and from 1000 to 5000 borrowers. The system reserves 160 characters for author and title, but if these are reduced the capacity can exceed 120,000 items.

Dubbed the Lothlorien Software Microcomputer Library System, this package was developed in consultation with the Sydney College of Arts Library. It is an online circulation system based on the Apple II microcomputer with 48K internal memory. Optional additions include the 20 megabyte hard disk, and a light pen or wand. All major functions such as circulation, catalogue searches and overdue notice checking can be performed simultaneously, using several Apple computers to timeshare the hard disk data bank. The software comprises an integrated set of twelve programs covering functions such as circulation, cataloguing, floppy disk back-up, bar-code printout, a standby circulation system, stocktake and remote telephone access. ■

What the

Computers have had a place in many schools for some time now, so we thought it might be interesting to see how children felt about their mechanical classmates. Researchers from Horan, Wall and Walker, 'The Information Agency', talked to children of all ages from a number of schools. The replies they received say a lot about how some schools are using computers and about how computer advertising is affecting what many children believe a knowledge of computers can do for them.

When computers were first introduced into Australian schools, there seemed a chance that the good old-fashioned blackboard school teacher was an endangered species.

Twelve months ago children were entirely wrapped in the idea of learning times-tables and simple mathematical problems from a computer screen, as well as playing new spacy computer games. At that time most said they found the computer interesting and challenging to learn from, while others were simply carried away by what they could do with graphics.

But our survey of Sydney school children showed that primary and secondary students are becoming more blase about the school computer. Could it be that the novelty is starting to wear off, or is it just the first phase of a new attitude to learning by children who have grown up in the computer age?

Naturally, there are still computer whizz-kids – the ones who succeed the square-eyed children of the 70s with their single-minded dedication to a new mechanical creation. But without much encouragement, a whole roomful of primary school children recently set to knocking the computer – saying it was boring, impersonal and not nearly as interesting a teacher as the very nearly outmoded 'chalky' variety.

Computer Boredom

Part of the reason was that most government primary schools have been limited to one small computer, purchased with the help of walkathons, spellathons and the occasional fete. So the computing experience of most in this group has been restricted to lunchtime and after-school stretches.

The children, who attend an inner city primary school in Sydney, said they could log-on to their computer only once a week. At first they had rushed to test-drive all the disks the unit had available, but after a year or so interest had waned. In any case, they said, you couldn't learn anything from the computer that the teacher couldn't teach in a more interesting and more personal way.

One eight-year-old pointed out that the computer was quite "dumb". It couldn't do anything unless you told it what to do. Another said the computer could only teach things in one way – but when you asked teachers a question they could explain something in more than one way to make it interesting for the student.

Chalkies Better than Chips

A couple of comments like these started a stream of computer criticism from the experts – the new era eight- to eleven-year-olds who are learning basic education concepts the way no other generation has.

"Trying to learn on a computer takes ages because you have to type the questions onto the keyboard – but if there is a teacher there you can just ask," was one very serious ten-year-old boy's comment.

One little girl said she loved learning on the computer. You could learn faster if you had managed to go onto another disk, while in a classroom the teacher would often go over things they "already learned last year".

But as another classroom colleague was quick to add, the number of disks available restricted their interest in the computer when they already knew things, such as times-tables, that the computer was bent on teaching them by heart.

Children at another primary school agreed they had never learnt anything on a computer that they did not already know. They said their teacher constantly surprised them with new topics and things to discuss – a knack that the predictable software of a floppy disk just could not compete with.

These rather unexpected children's comments seem to support the adult computer experts who say there is not yet sufficient educational software around to teach children things they can't already learn in another way.

"It's alright if you just want to go over things you've done already in class, and some of the games can help you learn your sense of direction and that, but I reckon it gets boring after a while," was another eleven-year-old comment.

Private Schools

Naturally, it's a different matter in wealthier private schools where there are often n or more terminals available school children. But even wit creased access and possibly understanding of how to use comp r programs, children seem to be aware there is nothing they can learn on a computer that a teacher can't teach them.

Sometimes teachers transfer parts of their lessons to computers, but much computing has been left to enthusiastic or specially trained teachers to teach interested children outside the classroom. ▷

kids think

What the kids think

Computer Gangs

Where children are allowed to decide whether they want such computer learning or not a rather uneven standard of computer education emerges; with computer fanatics, mostly boys, forming computer fan clubs and booking computer lunchtimes for months ahead on the school's only computer.

These children have been known to form computer 'gangs', distancing themselves from other children who are less interested in spending hours on end plugged into the terminal. The computer gang mentality has shaped a lot of computer activity in schools, especially when access is limited to one machine. If children aren't part of a fanatical group they tend not to gain much computer access, unless of course they have a computer at home.

One thirteen-year-old boy who was part of a group like this said his fellow enthusiasts made no attempt to encourage other children to become interested in the computer. "We wouldn't want to do that," he said, amazed by the question."If it became more popular than it is now there would be less time on the computer for us."

The computer gang mentality seems to be fired by one or two members who have their own computers at home. One eleven-year-old boy at an inner city primary school rather shyly admitted in front of his classmates that he had been given an award-winning personal computer for his birthday. A little prompting and he also admitted that this computer, superior to the one at school, had made it difficult for him to be bothered with the lesser machine to which his classmates had access.

His friends agreed that the school machine was not as powerful as his machine, and sympathised with his denunciation of the school computer. "He can use a better computer any time he wants to," said a grey-and-blue-clad mate.

Computer Learning for the Future

A group of high school boys took the school computer much more seriously. They even went as far as to say that the teachers knew nothing about how to operate the machine, which they had mastered at lunchtimes and in Year 8 computer awareness classes.

They said their conversation together was dominated by computer talk. And indeed it was. They knew the latest models, modes, functions and commands, and were even speculating – the kinds of robots that would develop in the next wave of the technological boom seemed to be a pet subject.

The more serious attitude of high school students to computers is perhaps attributable to the fact that they are closer to having to deal with the new social problems created by computer technology. Even Year 8 and 9 students were preoccupied with the need to beat the technological barriers to find a job when they finished school.

They seemed serious about their relationship with computers as a means to learn job skills, rather than as vehicles for learning school work.

Word processing was apparently a dirty word to one group of computer-mad teenagers. All they cared about was the nitty gritty data-processing and programming. "You use word processing in English and that, for poems and that," said one reluctant teenager, "but the teachers like

using it more than we do. I suppose it helps when you can do a neat draught of an essay or something, but I don't reckon it's much good – I'd prefer to do real computing."

Others said they liked the way you could use word processing disks to write neat draughts of school assignments – but added they would only use it for their favourite subjects.

One group of maths enthusiasts liked working on the computer because, they said, it expanded their scope for learning. Mathematical games were favourites because they ask a lot of questions and the students said they had to act quickly.

A common praise was that you could learn more about computers by programming them. "When you write games you learn a lot because they have to be interesting and challenging to hold your attention ," said a fanatical 15-year-old. "Nobody would want to play the game if it was boring and like all the other games – so it can be very creative in that way.

"Even if it is only a game," he continued, "it can still teach you a lot about the way computers work."

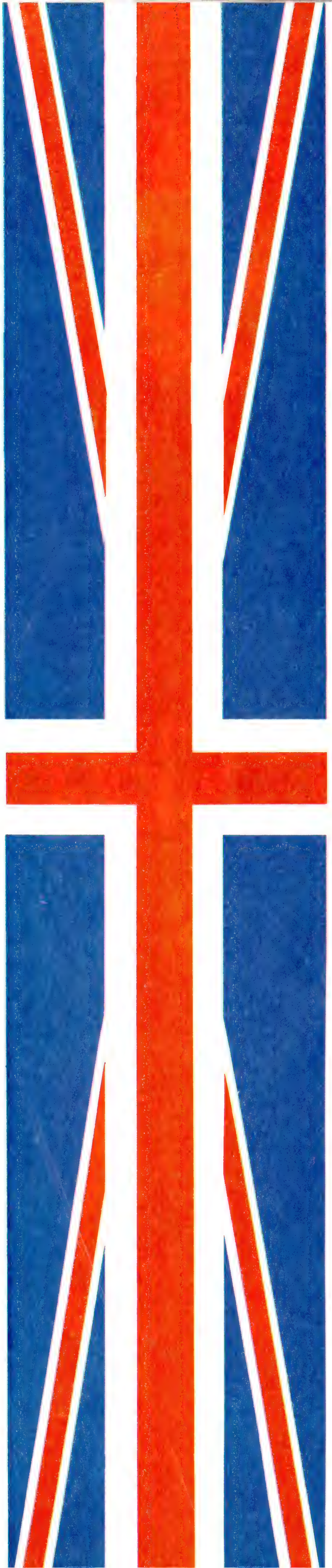
Computing for Better or Worse

School students in primary and secondary schools seem to agree that computer learning can really only reinforce what is already learnt the old-fashioned way in class.

It seems that the novelty which once threatened the credibility of flesh and blood teachers has worn off as schoolchildren have grown tired of the limited range of educational software available.

But older schoolchildren seem to look to the future, giving new micro-electronic creations their ultimate respect. They are also the ones who believe they will be saved by keeping pace with technology.

One group of Sydney high school students boasted that they would never have trouble finding a job because, unlike some superseded adults, whose technological outlook was still coming to terms with steam-driven engines, they would be able to operate what was new and complicated. They talked lightly of the jobs that were being lost as computers took over, but when they were asked if they feared unemployment because of the computer takeover they simply replied in collective reassured voices: "No, we won't be without jobs when we leave school – because we know how to operate computers." ■



Computer Education in the U.K.

Over the past four years fiche and chips have been enjoying a revival in British schools – although we doubt whether computers destined for educational use are delivered in the traditional week-old newspaper. In Australia, kids are still on a rather unbalanced computer diet. As this quick summary of the English computers-in-schools system shows, we could learn something from the British on dishing up computer-aided learning.

In March 1980, the British government announced its Micro-electronics Education Programme (MEP); by the end of 1986, when it is planned to close down the scheme, it will have been worth more than 20 million pounds to schools in England, Wales and Northern Ireland.

The British department of Trade and Industry has paid half the cost of a microcomputer for each of Britain's 5500 secondary schools, attended by children between the ages of 12 and 18. On top of that, each school has bought an average of a further five computers.

In July 1982, the pound-for-pound purchase grant was extended to the 27,000 primary schools attended by children between the ages of five and eleven. So far, about three-quarters have applied for a grant, which can be worth up to 1000 pounds.

Schools have a choice of three British-built machines, the Acorn BBC, the RML 480Z Link and the Sinclair ZX Spectrum – which are supplied with other pieces of hardware, including a cassette recorder and a monitor.

In addition, each school receives a starter pack of four software items containing programs designed to help teachers set up the system. Others illustrate the kind of computer-based learning that is currently available for younger children. The software is accompanied by explanatory booklets with sample worksheets.

Helping Teachers Help Themselves

Most importantly, the package contains a self-help foundation course on the basics of computing, and there are guidelines on the use of computers in lessons. The course consists of a teacher's manual, a booklet of background features, and two cassettes of case studies and simulations.

Understandably, most of the teachers in Britain, like those in Australia, know very little about how to introduce computer-based learning to the classroom, and so two teachers from every school applying to buy a subsidised microcomputer have to undertake special training. This usually involves going on a two-day in-service course organised by the local education authority, either before or after the computer has been received, coupled with the use of the self-study material.

From the start, teacher training has been a major feature of the

HERE IT COMES AGAIN... "HOWS ABOUT A BYTE OF FYCHE & CHIPS GIRLS..."
P&C T CK SHOP

MEP. Based in Newcastle, northeast England, and staffed by a small team of seconded experts, it has set up twelve regional centres in England and one each in Northern Ireland and Wales. There is a separate micro-electronics development programme in Scotland.

Tens of thousands of secondary teachers have now attended in-service training courses. To help local education authorities organise their own training schemes, a series of programs has been published, and these are sold to education authorities worldwide.

A cascade system of training is used by the MEP. Inspectors and advisors are trained, and then run courses themselves for teachers. They in turn are in a position to brief their colleagues about computing.

Please Sir, More Software

Triggered by the MEP, micro fever has spread at breakneck speed through Britain's classrooms – not least because children themselves have proved to have a natural affinity for the new technology. This has generated an insatiable demand for software, particularly for use with younger children.

Several educational publishers, including Heinemann, Longman and the Cambridge University Press, are directly involved with the MEP. They publish approved software developed by the four national units.

Since 1980, more than 1000 software packages have been produced under the auspices of MEP and distributed, at discount prices, to educational establishments.

Money is also available to subsidise individual software projects. For example, a group of teachers might want to develop a program that they believe will have more general appeal. In that case a grant might be made towards the resources needed – computer tape, disks and so on – although not necessarily for the actual time and skill of the people concerned.

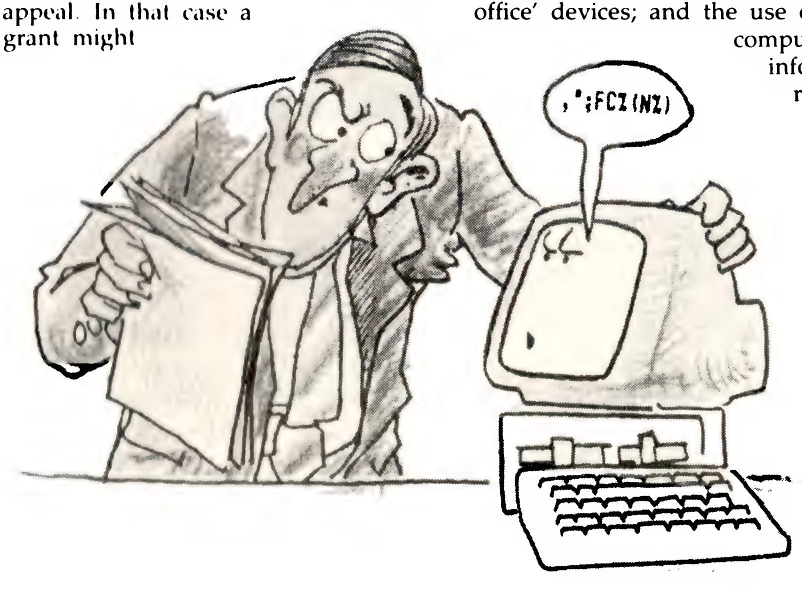
Some in-school groups that received government subsidies through MEP eventually turned into fully fledged entities. It was always the government's intention that as many such units as possible should be encouraged to exist independently of MEP and continue to function after it closed down.

It is coming to be generally accepted that, if computers are to have a valid role in the classroom, the software must be tailor made. As a teacher from London put it: "Bad software can lead to even the best teachers giving bad lessons." British teachers, like their Australian counterparts are now favouring 'content-free' programs which contain no suggestion of the 'right answer', so that users can interact with the machine in an exploratory and discursive mode of learning.

More Ways Than One

Much of the MEP's work deals with exploring the ways a computer can be used to help individual children or groups of children to tackle various aspects of the traditional curriculum.

Priority has been given to computer-aided learning in such subjects as mathematics, the sciences, craft/design technology, geography and clerical and business courses. MEP is also concerned with developing new subjects. these include microelectronics in control technology; electronics and its applications in particular systems; computer studies; linked studies, including computer-aided design, data logging and processing; word processing and other 'electronic office' devices; and the use of computers for information retrieval. ▷



In the U.K.

The programme also has an important function in helping physically or mentally handicapped children.

Rapid technological developments and ways of applying them have made new demands on the programme. Much interest has recently been generated in electronics – what actually goes on inside the mysterious 'black box' – and research has been carried out to develop and explore the use of kits of electronic components.

Knowing Where You're Going

Thus, under a centrally co-ordinated plan, British educators are addressing a range of computer-related learning possibilities. Their stated aim is to "prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive." Although each school remains independent in choosing software and in the way in which it uses the computers, a great deal of effort has been channelled into providing back-up to guide the teachers in their decisions and methods.

In Australia, the development of computer-related education on the whole has worked in reverse; starting with a scattering of a few keen teachers, this new area was subsequently taken up by governments, both state and federal, which still have not evolved a truly coherent strategy. Most obvious is the lack of a support structure available to all teachers.

That isn't to say that the Australian education system hasn't progressed considerably in its implementation of computers, or that the method used in Britain is perfect – our recipe just hasn't been as successful overall.

Although it would be ridiculous to suggest we should now emulate British methods of introducing computer education, Australian education authorities should take into account the British successes in this area when making plans for the future. ■

Here it is at last!

An easy-to-understand introduction to the mysteries of programming in Z-80 assembly language, written specially for owners of the extremely popular Australian-designed Microbee computer.

ASSEMBLY LANGUAGE PROGRAMMING FOR THE MICROBEE by Lewis Badham

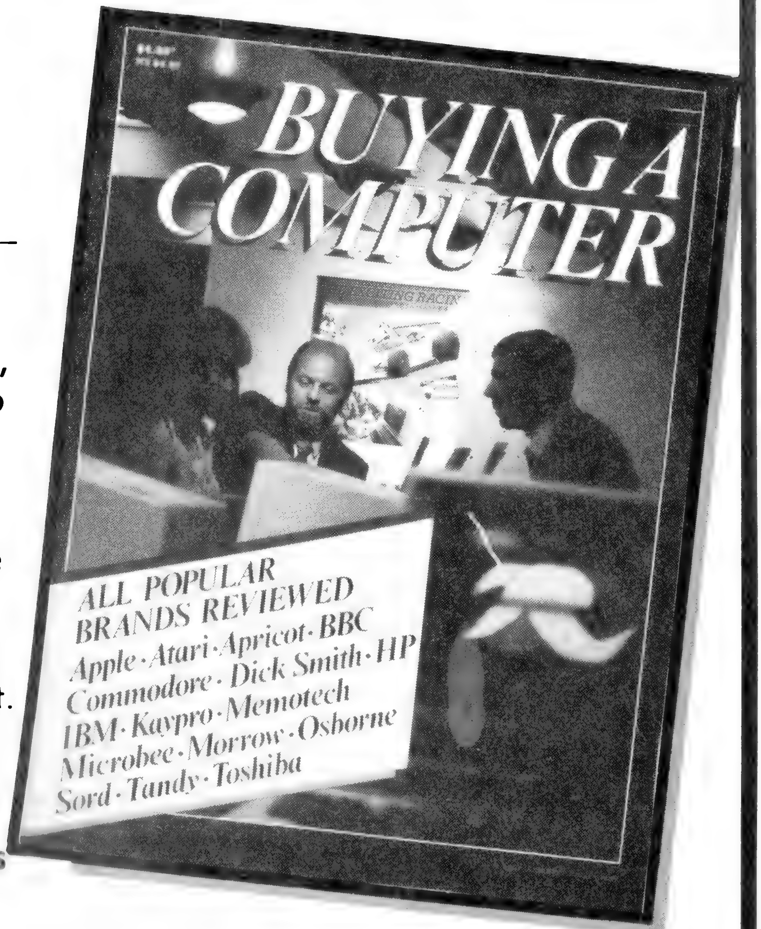
BASIC and other high-level languages are ideal for learning the essentials of programming, but sooner or later you become aware of their limitations in terms of speed and flexibility. The ideal 'next step' is to progress to assembly language, which allows you to manipulate the computer's own nitty-gritty instruction set. Trouble is, assembly language can be very hard to break into, without some help.

This book will provide you with that help. Written by an experienced Microbee programmer, it starts right from the beginning and guides you step-by-step. By the end of the book you'll be able to write mathematical programs, games programs with moving graphics and sound effects, and also be able to write things like "driver" routines to match your computer to a different printer.

Not only that, but you'll also have a much better understanding of how your computer works, and be in an ideal position to read more advanced texts. Assembly language will be no longer a foreign language !

At your newsagent for only $9.95!

BUYING A COMPUTER



When you produce Australia's best monthly computer magazine — 'Your Computer' — the most frequent question you encounter is "Which computer should I buy?"

There's no simple answer to this — it all depends on what you want to use a computer for, how large a task you have in mind, where you want to use it, and much more. But people still ask, so it seemed a good idea to collect together in one volume a large number of reviews and reports on Australia's most popular computers, so that people can read all the evidence side-by-side and form their own judgments.

'Buying a Computer' is the result. In it are reviewed more than 25 computers available in Australia, divided into three sections covering personal computers, business computers and portables. Everything from the Cat to the various Apples is covered, passing through such wonders as the Apricot, Rainbow, cash 'n' carry crowd — and of course the ubiquitous IBM. If it's available in Australia, the chances are it's reviewed in **'Buying a Computer'.**

In addition to the reviews are several general articles covering advice on what to consider when buying, learning fast when you're thrown in the deep end, a price list of computers ranging from $280 to $20,000, and descriptions of 1984's eight 'best' computers as judged in 'Your Computer's' Personal Computer of the Year Awards.

If you're thinking of buying a computer, for business or personal use, **'Buying a Computer'** is indispensable. It's the only way you'll get an objective opinion on just about every computer on the market.

Available from your newsagent now — price $4.50.

Computer Education in the U.S.

John Treloar was awarded a teaching Service Fellowship to the USA to investigate the use of computers in education in the first home of the silicon chip. He wrote about his conclusions for us on his return.

I went to the USA to attend various conferences and seminars and to study four aspects of the use of computers in education in that country. Summarised, they were:

1. Use of computers in the elementary school.
2. Use and operation of resource centres.
3. The development and implementation of inservice training for teachers.
4. Current use of computers in education in the USA.

Highlights

I was very interested to see the differences between school systems in the different American states; while I was in Minnesota, there was even a school district that had laid off its teachers for eight weeks due to lack of funds! Many school districts were in the discussion stages of their computer contracts and teachers were threatening strikes and other industrial action.

I had several discussions comparing New South Wales teachers' conditions (with which I'm most familiar in Australia) with the local American situation. Compared with teachers in some of the districts I visited, a NSW teacher is quite well-off. In Georgia, for example, the starting salary for a teacher is somewhere in the vicinity of $12,000; the local area funds the schools and relates the salary to the ability of the area to pay and how much it costs to live in the various towns or cities. The starting salary for a teacher in New York was somewhere in the vicinity of $24,000.

In an area in Washington where the population is elderly, the local community decided to cut funding to the local school district and instead spend more money on road improvements and facilities for the elderly. All money that is requested above the normal allocation has to be voted on by the community, and this includes the allocation of funds to computer education.

The US Federal Department of Education does not have a federal policy on the development of Computer Education as we do in Australia. There are federal funds available, but no countrywide plan. Overall my impression was that there is less centralised planning in the American school system than there is in the Australian system. A great deal of work is being put into local initiatives in local school districts, but there is no co-operation between districts. I saw, for example, the same work being done in California and in Florida. The people who develop the curricula, software, systems and so on also develop a feeling of ownership of their creations, which tends to lead to more separate development without reference to what other people are doing.

General Observations

There may be more computers in schools in America, but my impression is that despite this the computer education available is no better than over here. There are occasional pockets of brilliance, but overall there seems to be the same shortage of knowledge among teachers of what's really involved in computer education. Speakers at the conferences I attended would have you believe that computer education was fairly well advanced, but at the 'grass roots' level in the schools I found the same amount of confusion and doubt as here.

Schools which are developing the concept of the computer as a tool for learning rather than solely a curriculum subject seem to me to be on the right track and most likely to give their children real value from computer education – this is a lesson we're only just starting to learn in Australia, too.

Seeing such a lot happening in an atmosphere not so different from circumstances over here gave me more confidence in the progress and development of computer education.

Bank Street College

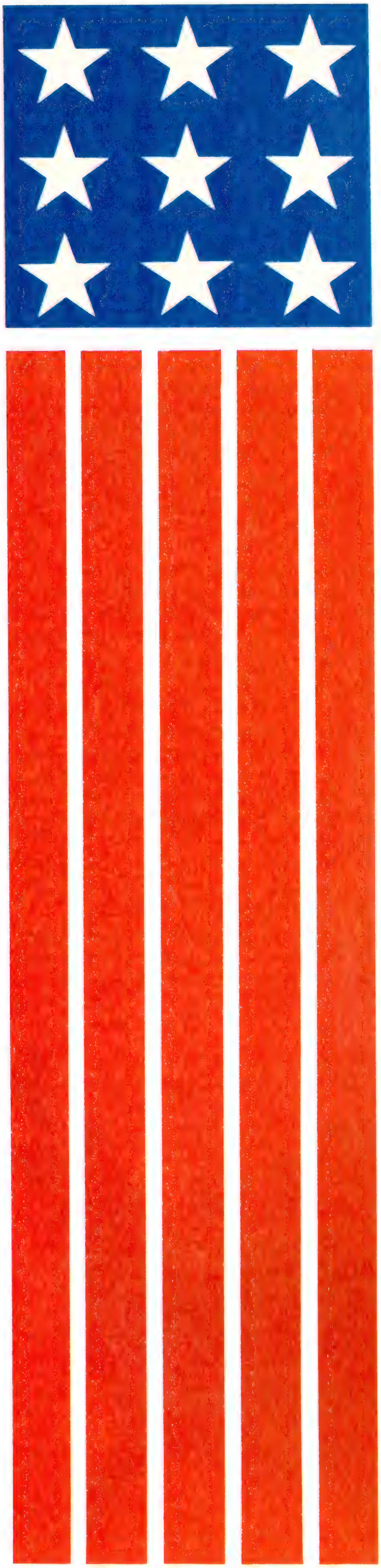
I visited a number of computer education institutions while in the States, one of which was Bank Street College – creator of such well-known programs as the Bank Street Writer word processor. I was expecting the staff to be very aware of the purpose and future directions of computer education, but found to my amazement that even they are not really sure which educational software is good, and why. They were asking as many questions as I about what to do with computers.

The main software used in the school is Bank Street Writer, and the school has a number of computer labs which are used for all computer activities. The children both use computers and write in the conventional manner in the classroom. They discuss the content of what they've written with their partner, then check for spelling and punctuation errors using software.

The process followed in the school for any kind of written work consists of:

Write
Ideas – detail
Rewrite
Check for punctuation, spelling and so on.

The discussion between partners is very interesting and warrants some investigation or research. The use of language and interaction between the children is not restricted to spelling and punctuation, but also includes



the syntax and semantics of the piece. The children seem to be at ease with the operation of the program and there is no problem of the technology getting in the way of the writing. They keep track of their progress in a folder which has a table of contents and printouts of their writing. They have all learnt the important lesson of saving their work as they go!

Some of the teachers emphasised that human contact is to be encouraged more than the 'flash flash' of computer programs, but still agreed that computers can help us rethink education. We can do this through the use of the computer as a tool, for example as a word processor, and for operating databases, accessing sources of information through data communications, and using problem-solving programs to simulate real-life situations. This kind of computer usage shouldn't run the risk of immersing children in technology at the expense of contact with people and everyday situations. ▷

Computing in the **U.S.**

Evans Computer Magnet School

I spent two very useful days with the children and staff of the Evans Computer Magnet School in Yeadon, Pennsylvania. The concept of a magnet school seems strange to Australians and needs some explanation. All the elementary schools in Yeadon have to balance their school populations in line with the desegregation policy. In 1981 the school population was 57 per cent black. The schools could have chosen to 'bus' the children to other schools and balance the numbers that way, but instead decided to attract more white children to the predominantly black schools. This was done by making the black schools 'magnet' schools. Another of the schools in this position has become a 'back to basics' school and a third has placed emphasis on the creative arts. The Evans Computer Magnet School now has a 32 per cent black community, has got rid of many of the problems it had before, and the teachers are keener and very enthusiastic, as are the children.

The school has a computer room with twelve Atari 800 computers and one printer, having found this a more efficient way of organising the equipment than spreading it around the school. Atari Pilot is used as the main instructional tool. I was very impressed with the children's confidence in using the computers; they had no fear and were willing to try anything. Their mastery of cursor movement and general control of the computers was a credit to the teachers and the comprehensive curriculum they have developed. Some of the younger children were even practising their keyboard skills using overlays on the screen.

It is important to point out that there are no 'computer experts' on the staff of this school; they are simply dedicated teachers who have encompassed computer education into their curriculum, very similar to the situation in many Australian schools.

In all sessions on the computer the children worked in pairs or in threes. This worked very well, and was encouraged by the teachers, who had developed activities that needed the children to interact with each other.

Education USA

Education USA is a publication of the National Schools Public Relations Association. It is presented in two forms, one as a printed newsletter and the other through on-line computer access, called ED-LINE. ED-LINE is transmitted through the Source, a national on-line database. Schools and educators across the country can dial up the Source and access ED-LINE at any time of day and read the latest information on developments in education. The information covers:

- Latest news relating to education
- Management ideas
- Legal briefs
- Federal alert (federal happenings)
- Excellence in education
- Ed exchange
- What's new in research
- Classroom ideas
- Useful facts and figures
- Curriculum ideas
- Classroom new products

The information is updated twice a day, offering a morning and an afternoon news bulletin. The service offers teachers and administrators across America the opportunity to be always up to date with the latest research and to be aware of bills that are passed in various state legislatures. There is also the opportunity to set up networks across the country for teachers with similar interests and ideas.

The system has been developed over the past six years and is now moving toward having a student hook-up. I discussed the possibility of a world link-up in the near future, which is by no means out of the question with the development of the world satellite system and communications in general.

Recommendations

Based on the combination of my previous experience in New South Wales schools and new ideas from my visit to America, I have some suggestions to make about the development of computer education in this country.

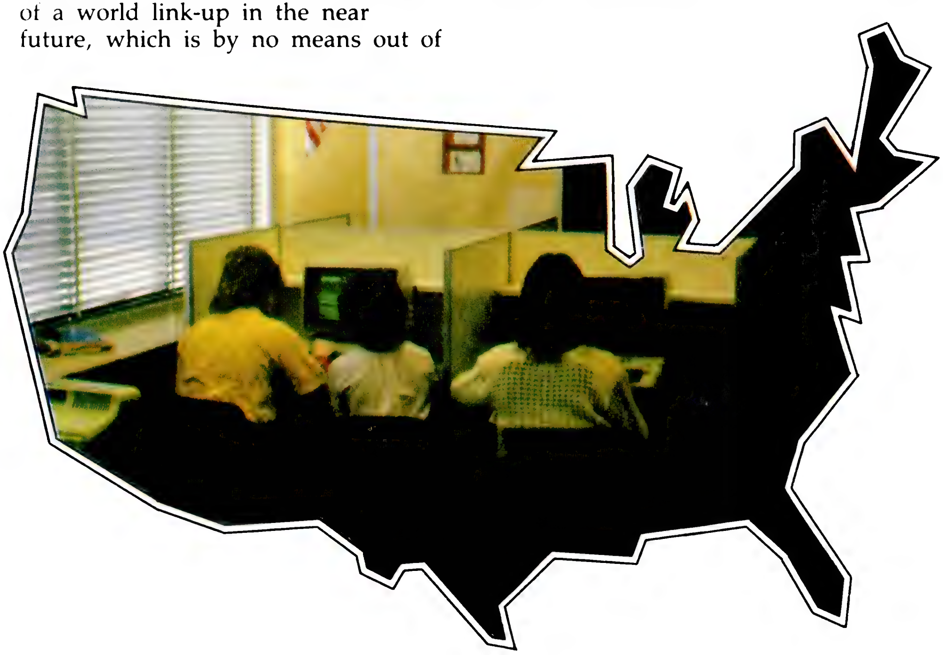
1. The education departments should employ more consultants for each educational region in each state to implement the departments' policies and the courses that will be offered in secondary schools in 1985.

2. Resources should be directed right across the years from Kindergarten to Year 12, with greater emphasis than at present on years K to 6. This is based on my experience in America, where some of the more imaginative and effective work is done in the elementary schools.

3. A telecommunication link should be setup via AUSTPAC and the American Source, to link American children with Australian children through the available technology.

4. Involve trainee teachers more in computer education so that they know what they're doing when they come into service in schools. This is an area that needs development and is one that is well established in America.

5. Continue with the developments as planned, as to my mind these can offer more than I saw in America, in particular (in New South Wales) the development of secondary courses and the work of the Curriculum Project Team. ■



One of the major obstacles in coming to grips with computers and dealing with computer sales people is that almost everything you read or hear is heavily laced with jargon. A basic knowledge of what the terms mean can allow you to approach the issue with a clear head, and avoid the computer hangover which comes with making a bamboozled decision. This glossary should help.

Access: To read or write from a location in memory, or a file, or disk.

Address: A memory location which can contain data or an instruction.

Algol: Algorithmic Language. An early computer programming language for mathematical applications. Widely used in Europe, it embodied early structured programming concepts and was a precursor of Pascal.

Algorithm: A set of instructions which define a method of obtaining some result (usually mathematical). A cooking recipe is an algorithm, as is a knitting pattern.

Apple: The Apple II computer is based on the 6502 microprocessor with an integrated keyboard. Noted for its colour graphics capabilities, which make it popular with schools.

Application: What you do with your computer. For example games, word processing and graphics.

ASM: Assembler. Also a suffix added to assembly language file names under CP/M to distinguish them from other files with the same name.

Assembler: A program which converts assembly language into its corresponding machine (or object) code, which can be executed by the computer.

Assembly Language: A language in which each machine code instruction is represented by a short mnemonic which is much more comprehensible to the programmer. For example, the 8080 machine code
[10010110]
in binary, is
[SUBL]
(subtract L from accumulator) in assembly language. Each line of assembly language becomes one machine instruction.

Back-up: An extra copy of a disk, tape or file taken as a precaution against damage of the original.

BASIC: Beginners All-purpose Symbolic Instruction Code. Invented in 1970 at Dartmouth College by Kemeny and Kurtz as a teaching language, it has since been enhanced in its more exotic forms into one of the most sophisticated yet easy-to-use languages available on personal computers. Its major rival is Pascal, which has the added virtue of stressing structured program design.

BDOS: Basic Disk Operating System. The major functional component of the CP/M DOS.

Binary: The base 2 system of counting used by digital computers.

BIOS: Basic Input/Output System. The part of the CP/M operating system which is different for each type of machine and provides any special I/O routines for disks, terminal, printer, and so on.

Bit: Binary Digit being the basic unit of data storage. Either 1 or 0, off or on, true or false.

Boot: To load the operating system into the computer from a disk or tape, either initially or subsequently after running a program.

Bootstrap: To use one short program to load a longer loader program which then loads the operating system.

Buffer: An area of memory used for temporary storage while transferring data to or from a peripheral such as a printer or a disk drive.

Bug: An error in a program. Makes programmers itch.

Bus: A set of wires over which data, addresses, or control signals are transferred between the central processor and memory or I/O devices.

Byte: A computer word eight bits wide. A byte in memory can hold a character or a binary number between zero and 255 (or –128 and 127), or a computer instruction.

C: A programming language, developed at Bell Labs, which is particularly convenient for writing system utility programs.

CBASIC: A commercial version of the BASIC language, running under the CP/M operating system. Doesn't use line numbers on every line, and is compiled, rather than interpreted like Microsoft BASIC.

CCP: Console Command Processor. The part of the CP/M operating system that reads a command line and sorts out what it means.

Chain: To automatically run one program after another.

Character: A letter or number, or in some circumstances a control code such as 'carriage return'.

Checksum: A running total of the characters in a file, recorded or transmitted with the file so that errors can be detected.

Code:

Absolute: Machine instructions which are intended to be loaded and executed in a particular area of memory.

Object: Machine instructions, as distinct from the source code from which it was generated.

Re-entrant: Code which can be loaded and run anywhere in the computer's memory.

Source code: A program written in assembler, or a high level language such as BASIC, which must then be assembled or compiled to produce the object code which can actually be executed.

Cold Boot: To start up a system from scratch, loading the operating system from disk or tape.

Cold Start: See Cold Boot.

COM file: In CP/M parlance a command file; that is, a machine code program that can actually be run.

Command: An instruction from the console for the system to do something.

Comment: A note added to a program to help the reader (or programmer) to understand its operation. Does not affect the program's execution in any way.

Compiler: A program which accepts as input a source file written in a high level language, and produces as output an object file containing the machine instructions which are actually executed.

Computer: Are you serious?

Console: The keyboard and screen from which the operator controls the computer.

Control characters: Codes which perform functions like acknowledging correct receipt of a message or requesting retransmission of an erroneous message. Control characters are defined as part of the ASCII and similar codes.

CP/M: A disk operating system for 8080- and Z80-based microcomputers. Allows the user to store information and programs in named files, as well as managing disk storage and input/output functions. Other disk operating systems include TRSDOS (on TRS-80) and DOS 3.3 (for Apple).

CRT: Cathode Ray Tube. Usually refers to the screen of a video terminal or the terminal itself.

Data: Information to be processed by, or output from, a program.

DDT: Dynamic Debugging Tool. A Microsoft program that assists the user to find errors in machine code programs.

Debug: To locate and fix errors.

Directory: A list of the programs on a disk (or occasionally tape) together with necessary information, such as length and location.

Disk: A flat, circular magnetic surface on which the computer can store and retrieve data and programs. Is fast compared with tape, particularly when access is not one item after another.

Disk Drive: The mechanical assembly which rotates the disk and positions the read/write head.

Disk Operating System: A program which operates one or more disk drives automatically and manages the system.

Display: The computer's output device at the console, usually a TV-like display of letters and numbers; sometimes the computer can produce graphics (charts and pictures) on the display.

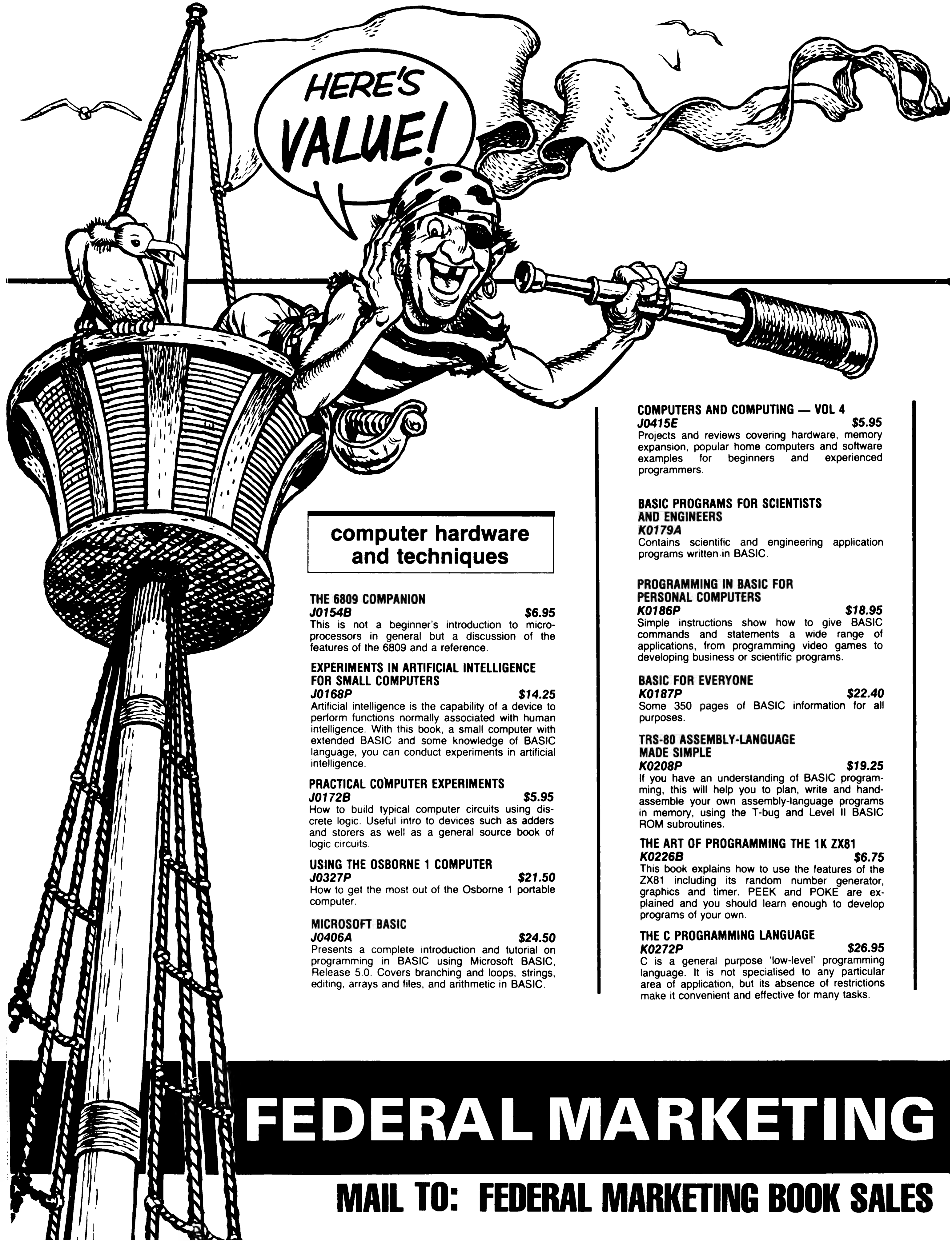
Double Density: A method of recording twice as much information on a floppy disk, which requires a higher quality recording surface than on a single-density disk.

Dump: To list out the contents of memory or a disk.

Echo: When the computer inputs a character from the keyboard, it then sends it back to the display so you can see it was received correctly.

ED: An editor program; part of CP/M.

Editor: A program which lets you alter and correct source files and other documents.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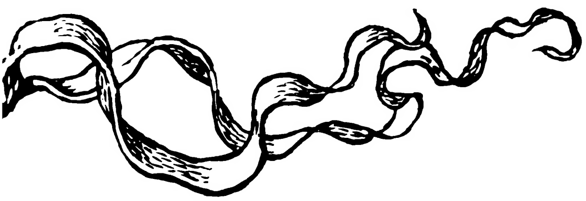

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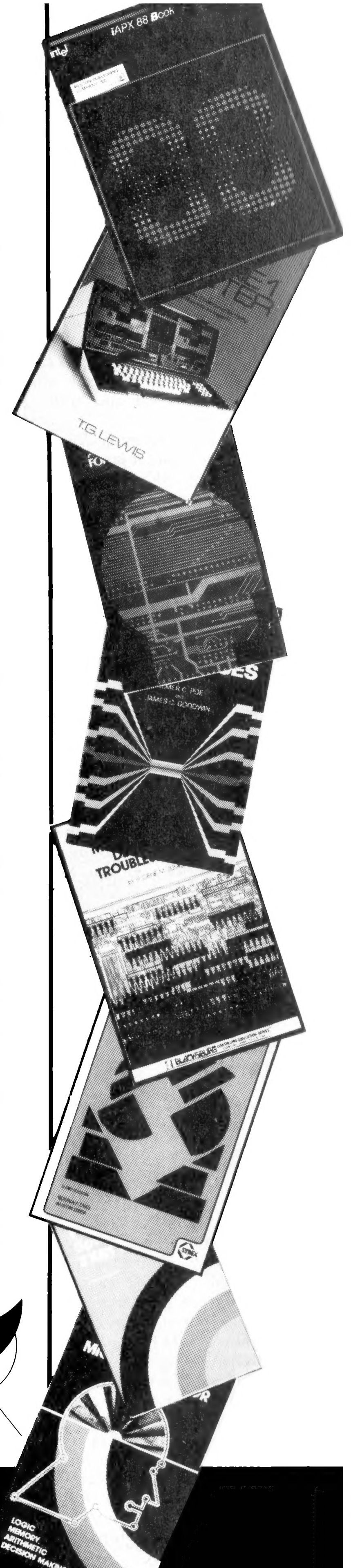

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Error Message: Tells you something went wrong, and sometimes what.

Execute: To run a program; to follow its instructions.

File: A continuous collection of characters (or bytes) saved on a disk or tape for later reloading.

Flag: A variable, sometimes a single bit, which can have only two values and is used to indicate some condition.

Floppy disk: A disk, made of thin, flexible mylar, and enclosed in a card jacket, which can be used for magnetic storage. There are four varieties, 7.5 cm, 9 cm, 13 cm and 20 cm. These can typically store somewhere between 140,000 and three million bytes (characters).

FORTRAN: Formula Translation. One of the first computer languages, and beginning to show it, although still the king of the scientific or number crunching languages.

Function: A sub-program that processes variables in some well-defined way.

Garbage Collection: The process of going through memory or disk space and reclaiming all the redundant used space.

Global: A variable which is known to all the parts of a program. See local.

Hard disk: A disk made of hard material, which is larger, faster and more fragile than a floppy disk, but capable of storing 70 million bytes or more.

Hard Copy: Printout.

Hardware: The bits of a computer you can kick, as opposed to the programs you can only swear at.

Hexadecimal: The method of counting to the base sixteen or the method of splitting binary digits into groups of four, which is the same thing. In hex, you count: 0 1 2 3 4 5 6 7 8 9 A B C D E F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1F 20 21 22.

Identifier: A label, or the name of a variable.

Iff: If and only if.

Index: A variable which usually points to an entry in a table or list.

Input: To get data into the computer.

Instruction: A step the computer can perform.

Interpreter: A program which examines source code a line at a time, decides what it means, and then does it. Compare with compiler.

Interrupt: To electronically drag the computer away from what it is doing in order to respond to some time-critical situation.

I/O: Input/Output.

Jump Instruction: Normally, control proceeds from one instruction to the next, one after the other. A jump instruction passes control, not to the following instruction, but to some other. Jumps can be conditional.

Kilobyte: 1024 bytes (Kbyte or K).

Kilobaud: 1000 baud (kbaud).

Language: The set of instructions, and rules for stringing them together, which you use to instruct the computer what to do.

Library: A set of programs, or sub-programs that can be called from your program so you don't have to waste space with a block of commonly used code, for example, a date routine can be held in a library.

Line Printer: A high-speed printer for computer output.

LISP: A list processing language, much favoured by the artificial intelligence community.

List: A sequence of consecutive data items.

Load: To transfer some data or program into the computer memory.

Logical Device: A device as the computer 'sees' it: what the computer regards as the 'list device' may be one of several 'physical devices', such as a line printer or teletype.

Loop: To repeatedly execute a sequence of instructions; part of a computer program that is so executed.

Machine Language: The binary codes the machine actually executes.

Macro: A user-defined sequence of instructions which can be inserted anywhere in a program. See Library.

Macroassembler: An assembler which can utilise macros.

MBASIC: Microsoft BASIC, the BASIC used in the TRS-80, PET, Apple II and so on.

Memory: Where the computer stores data and programs internally for fast access.

Menu: A display which offers the operator a choice of several alternatives.

Microcomputer: A small computer based on a microprocessor.

Microprocessor: The central processing unit of a computer, built into a single silicon chip.

MP/M: A multi-user version of CP/M.

NAD: A name and address file maintenance program.

Number Cruncher: Machine specifically designed to perform arithmetic operations at high speed.

Numerical analysis: The art and science of number crunching.

Object code: Machine code.

Object file: A file containing object code.

Optimisation: Making a program work better (or faster, or using less memory).

Page: A length of memory, typically 256 bytes.

Parity: An extra bit on the end of a character or byte for error detection.

Pascal: A modern structured language which may eventually rival BASIC in popularity or microcomputers.

Password: A secret word the system may demand of you before allowing you access to certain (or all) programs or data.

Patch: A temporary (ha, ha) fix on a bug.

Peripheral: A piece of equipment the computer uses, like a printer, disk drive, or modem.

Peripheral driver: A program which outputs data to a peripheral and controls it.

PIP: Peripheral Interchange Program. A CP/M utility for copying files between devices.

PL/1: Programming Language /1. A good general purpose commercial language.

Poll: To ask a peripheral if it requires service.

Preprocessor: A program which does part of a job to make life easier for the program which follows; for example, a macro processor before an assembler.

Priority: The resolution of which interrupt is serviced first if two should arrive at the same time.

Program: A sequence of instructions which can be understood, and ultimately followed by a computer.

Prompt: A message asking the operator or user to supply information.

R/O: Read Only; cannot be overwritten.

RAM: Random Access Memory.

Random Access Memory: The computer's internal memory which is used to hold running programs and data. The computer can both write and read RAM.

ROM: Read Only Memory

Read Only Memory: Internal computer memory used to store programs, which cannot be erased or overwritten.

Reader: Paper tape input device.

Read/Write head: The small coil which reads and writes on the surface of a disk.

Reconfigure: To reorganise the I/O or other aspects of a system.

Record: A set of related data items. For example, an employee's name, address, payroll number and pay rate would form a record.

Recursion: The ability of functions in some languages to call themselves.

Re-entrant code: Code which can be used by several programs simultaneously, keeping separate data for each.

Run: To execute a program.

Save: To store a program on disk or cassette (particularly BASIC).

Sector: A section of data on a disk.

Software: Programs.

Source code: The original text form of a program.

Sort: To arrange items of data in order.

Spool: To output a file to a peripheral, usually either a printer or tape.

Stack: A list in which both entries and removals are made at the same end. A microprocessor usually has a hardware stack which is used to save subroutine return addresses, temporary storage of data, and to pass variables between subroutines.

String: A sequence of characters.

Subroutine: Part of a program which can be accessed from several points within the program.

System: A collection of hardware and software, possessed of the property that the whole is greater than the sum of the parts.

System disk: A disk carrying the operating system.

Timeshare: Running several programs on a system simultaneously.

Track: The area under the read/write head during one rotation of a disk.

Unix: A multi-user, multi-tasking, multiprogramming operating system.

Verify: To check that data written on a disk or tape can be read again correctly.

Virtual Memory: A technique allowing programs larger than RAM to run. Only part is in memory. Parts are swapped from an on-line storage device as required.

Warm boot: To reload the operating system a second or subsequent time.

Word: The amount of data fetched from one memory location. Typically one byte, but can be two on recent processors.

Word processor: A system for manipulating, editing, printing and formatting text files.

Write protect: To remove the cover from the notch in a floppy disk so it cannot be written on.

Z80: A popular 8-bit microprocessor. ❑

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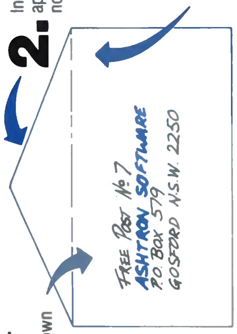

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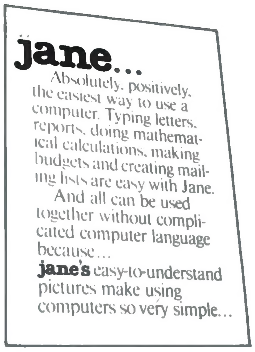

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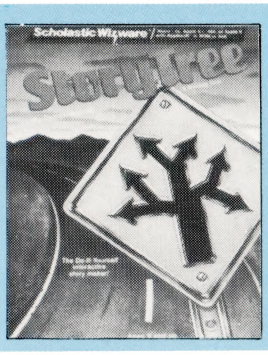

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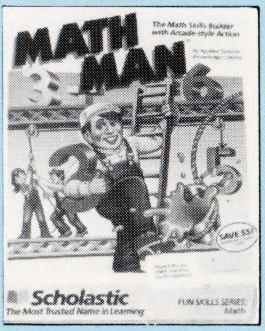

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